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MODEL ENGINEERS'

WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

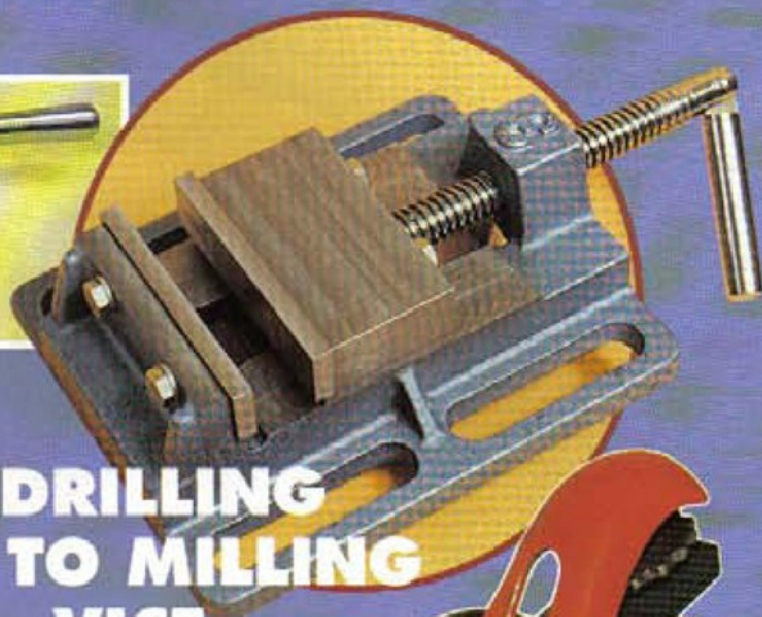


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PLANES**

**Tricks for optimum
performance**

**LAPS &
LAPPING**

**The technique
revealed**

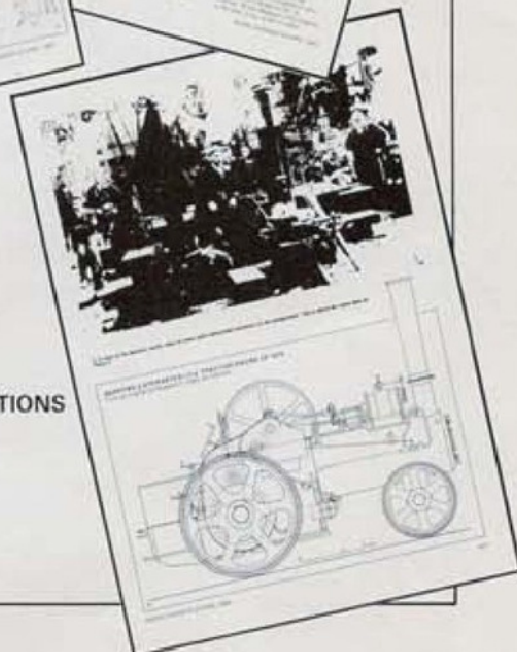
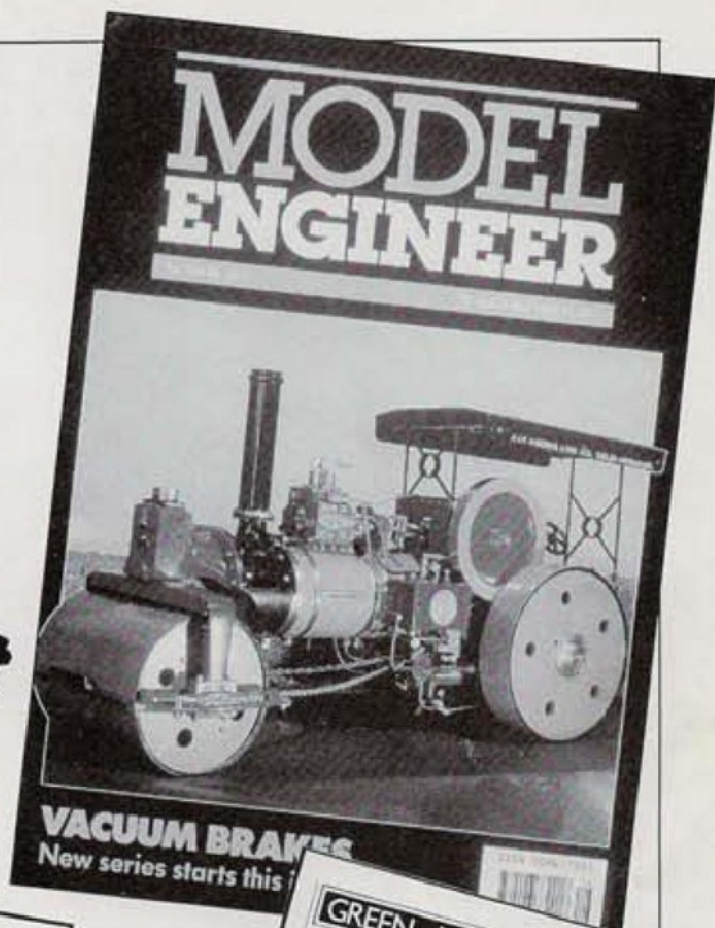
**DON'T MISS
SANDOWN PARK
MODEL EXHIBITION
AND DISPLAY
14TH-15th MAY
1994**



ARGUS SPECIALIST
PUBLICATION

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VALUE**

**SOMETHING
TO LOOK
FORWARD
TO...**
...every fortnight



There's something to anticipate twice every month in fascinating Model Engineer magazine! Whether your interests lie in live steam locomotive models, traction engines, internal combustion motors or stationary engines, world famous M.E. will inspire, instruct, advise and encourage. Model Engineer is published on the first and third Fridays each month and costs just £1.40 from all good newsagents; alternatively, you may care to ensure your regular copies through an annual subscription – a mere £33.60 for UK readers (overseas rates and airmail details on request).

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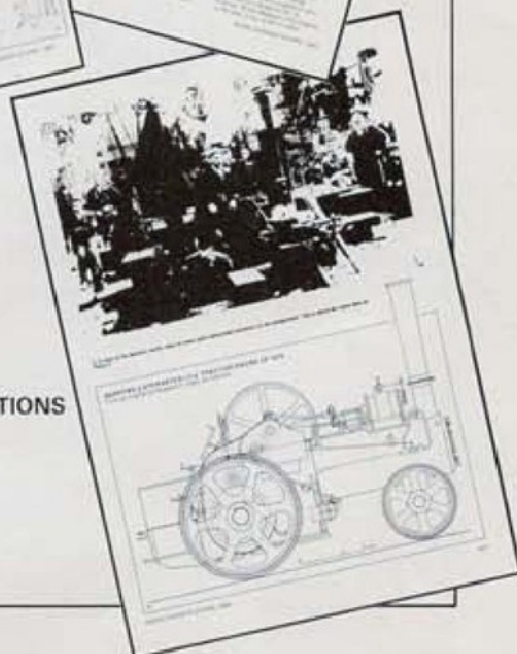
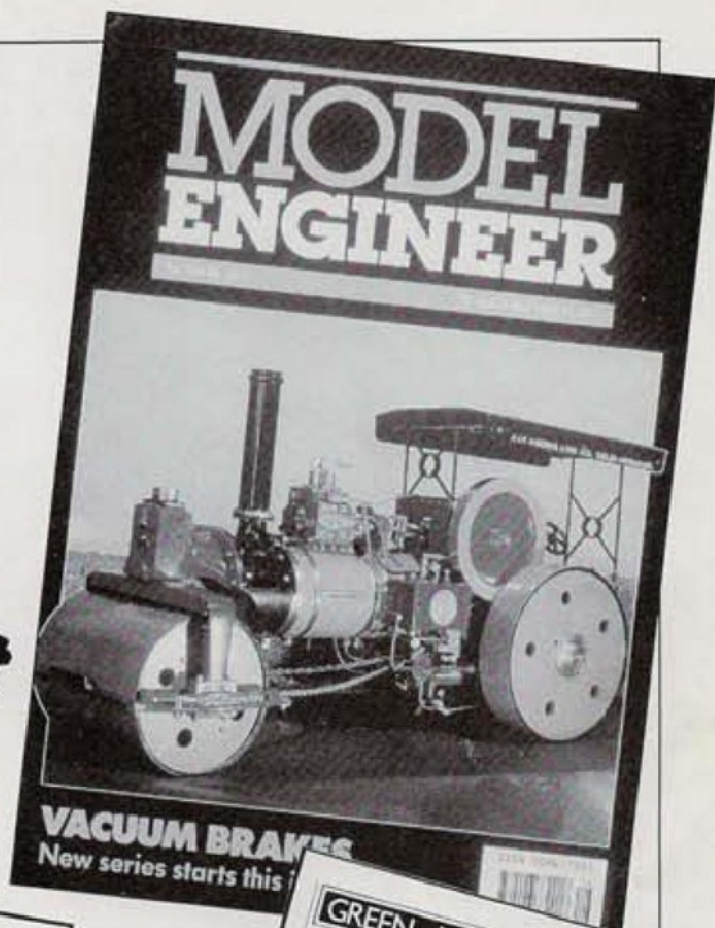
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Harold Hall

ON THE EDITOR'S BENCH

This issue sees a magazine with rather more in the way of workshop based articles than has been the norm for quite a number of issues. The reason for this is partly coincidental and partly intentional. The content of the magazine continues to bring in much more than the occasional item of correspondence, most of which is complimentary. I think I can also say that all of the recent letters that have mentioned some disquiet with the magazine, have also made it clear that they are otherwise more than happy with M.E.W.

Shaping up

Even though, as I write this editorial, issue 22, with the article on the shaper by Bill Morris, has only been available for some three weeks, there have already been many letters of appreciation. Bill, has provided some information on using a shaper, and illustrates this by making a vertical slide for use on his lathe. This makes an admirable article in its own right without its shaper content and will appear next time. Incidentally, if you had not already guessed it, it was Bill seen on the front cover of the last issue.

Computers and CAD articles?

Another series that has resulted in much comment is that on the computer and CAD. A number of readers have made the point that there are a multitude of magazines available on the subject of computers, and that is the place to go looking for such articles. I feel however that the very fact that there are so many, makes it advantageous for such articles to appear in M.E.W. One would have to spend a considerable amount of time, and money, searching through such magazines until a suitable article surfaced. The few I have seen on CAD have been far from satisfactory when considering the practical needs of readers of this magazine.

However, it appears that those articles which are not acceptable to some, are the very articles which bring in the most correspondence, some seeking further help, others just expressing gratitude. A few such letters appear in *Scribe a Line* in this issue. Articles such as this will continue to appear, though on the subject of computers rarely, and on CAD, not as extensively as those just published. The main aim of M.E.W. is the workshop itself, and I feel this issue is evidence of this aim.

Please excuse me if I concentrate on this issue but there are some very relevant points which I feel deserve an airing.

The bench press

The series of articles on the bench press

was another that was well received. I suggested there might be someone professionally involved, who could comment on die width and its effect on the pressure required when making bends. This has brought in an interesting short item from Terry Gould on his experiences in working in a commercial sheet metal environment.

Whilst his involvement is almost all with much thicker materials than would normally appear in the home workshop, practically all of his comments are of interest to the owner of a bench press. He even confirms that using unhardened punches and dies is a practice used in his company.

Air tools

Whilst considering industrial practices, it is worth mentioning a request from a reader regarding these as the subject for an article. He suggests that an article on air tools would be a worthwhile addition to the M.E.W. range of subjects, and I entirely agree. This is, I feel, almost entirely an industrial practice; though no doubt there are a few home workshops with this facility. We are looking for someone from an industrial background to provide such an article. It will need to be aimed at the possibility of it being used at home, albeit this may only be for a minority of readers.

Even so, we would have said that with regard to owning a milling machine only some twenty years ago, and now around half of workshops have that facility. If you feel able to provide such an article, please write first before spending much time on it, just in case there is more than one offer.

Types of articles received

The subject of articles has been a continuing one for this column since the magazine was started, now almost four years ago. With the magazine now that old, a pattern is beginning to emerge with regard to available articles. Without going into detail, it briefly equates to a more than adequate supply of smaller articles, but a very noticeable shortage of well illustrated larger constructional items. Supply of other articles is just about adequate at present. I have not made these points in an endeavour to dissuade readers from sending in smaller items, as some little gems appear amongst them. Also, as is evident in this issue, a few more smaller items will probably appear in the future than has been the case in the past. My main quest is to encourage any reader who has a major project in its early stages to start taking some photographs from its

onset, so as to make possible an article on its completion.

Whilst I say major project, articles are limited to two issues for constructional items, though a third part may be acceptable if it relates to using the device or making some optional accessories.

Index

I was interested to read in the 4-17 March issue of *Model Engineer*, received just a few days ago, of the efforts of Henri Larose of California U.S.A., in providing a computerised index for that magazine. It would appear that there are quite some similarities between the method he is adopting, and that on which I have been working for the last three months for M.E.W. He has, in addition to writing the programme for the system, provided entries for M.E. over a period of 33 years. I estimate in excess of 1000 issues, I have just 22 to look through. Anyone taking on such a task I feel deserves a medal.

I have now, in addition to finalising the programme, to read carefully through the issues to date to arrive at a satisfactory index. This will include letters, quick tips, trade and embedded items, generally listed in accordance with the method adopted for past printed M.E.W. indices, which have, with only one exception, met approval in principle. I will start at issue 20 and work back over the last two years, when an index will be published for that period. If this gains sufficient approval, a similar index will then be published for the remaining earlier issues. Future indexes will be published every twelve issues. One possibility of the computerised version is that in addition to being available, view only, a version will be available that will permit the editing of existing records, and the adding of new ones. This will allow editing those records that do not tally with the viewers interpretation, but more important will permit the addition of records as new issues of the magazine are published.

Help needed

I am looking for a small number of readers to test drive the programme, this is not to comment on the accuracy of the entries, which will only be for a few issues, but to comment on the programme facilities. You will need a 286 machine or later with at least 1M of memory, though I think perhaps it may be a little on the slow side at this, 2M will be preferable. A hard disc will also be necessary.

If you are interested in helping in this way please write giving details of your machine and the disc capacity. 5 1/4 in. discs cannot be made available at this stage. Readers who help in this way will of course receive a free copy of the final system complete with viewing and editing facilities.

REMAP

A reader in *Scribe a Line* mentions having made his machining expertise available to REMAP, The Rehabilitation Engineering Movement Advisory Panels. This is an organisation which I intended to mention for a number of issues. I have however run out of space again; it is too important a subject to give it just a passing mention. I will therefore ensure that it is given priority in the next issue.

HANDY SCREW JACKS

I wonder how many readers attempt to get by without a supply of screw jacks in the home workshop. Alan Jeeves suggests that every machinist should have a set. Why not take a break from your present project and spend an hour or two making some to add to your equipment

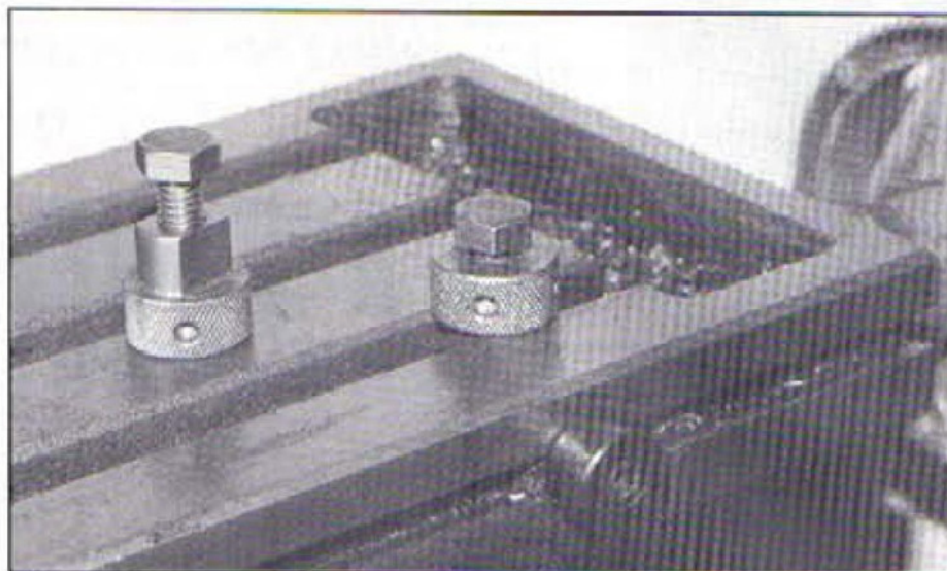
I am not short of setting-up aids for my mill/drill. There's no need to be when they are so simple to make, and the material is usually obtained from the scrap box. My workshop abounds with screw jacks of all sizes, but one particular type is often admired by visitors, who usually go away with the intention of making a set for themselves.

I have, over the years, taken for granted these most useful of accessories, but have been persuaded to tell a wider audience how I make my favourite type. I should say at the outset that the idea is not my own. They are a copy of a product which was around half a century ago, called (I think) the "Midget".

I believe that many home workshop owners will be grateful for the opportunity of being introduced to them, their main feature being the fact that they can sit low on the machine table and be used as clamp packings on small jobs. They are able to do this because, owing to the two flats which are milled on the neck, they are able to enter the Tee slot up to the shoulder with very little of the body above the surface of the table. The screw can be raised or lowered as required with the confidence that there is plenty of thread in the body to offer support.

An additional feature of this adjustable jack, is that the body can be reversed and used on the surface of the table in a conventional manner, the collar now becoming the foot. The diagrams should make all clear. The dimensions which are given are those which have been found to be convenient; they can be amended to suit individual requirements.

Little remains to be said about this simple design. Make a few, and see for yourself just how useful they really are, remember to make them to fit your Tee slots to gain the full benefit from their use. I believe that the original product was case hardened; you can treat yours similarly if you wish - mine are left soft and have been around for many years giving regular trouble free service.



Two jacks set up in their alternative positions.

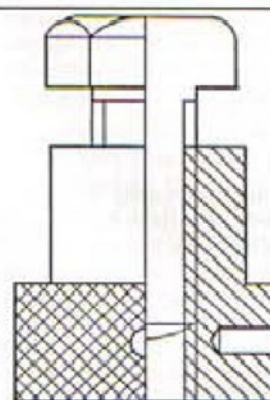
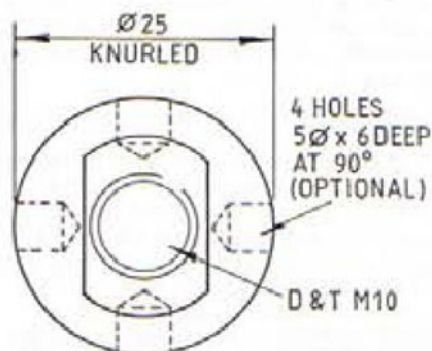


FIG. 3 HALF SECTION OF SCREW JACK

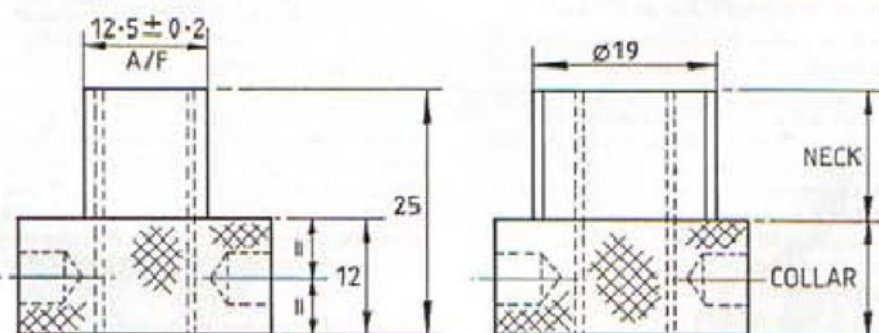


FIG. 1 SCREW JACK BODY : MILD STEEL

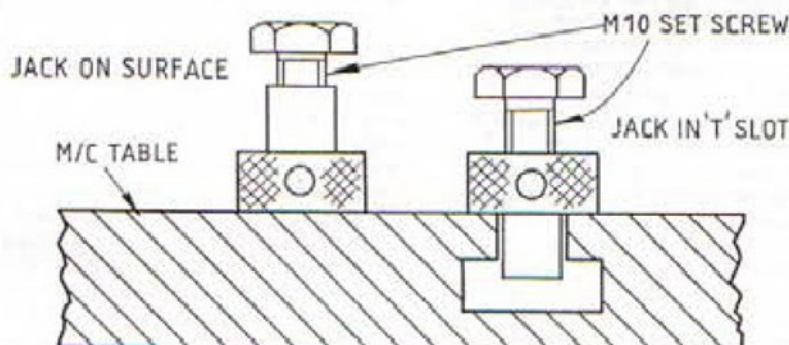
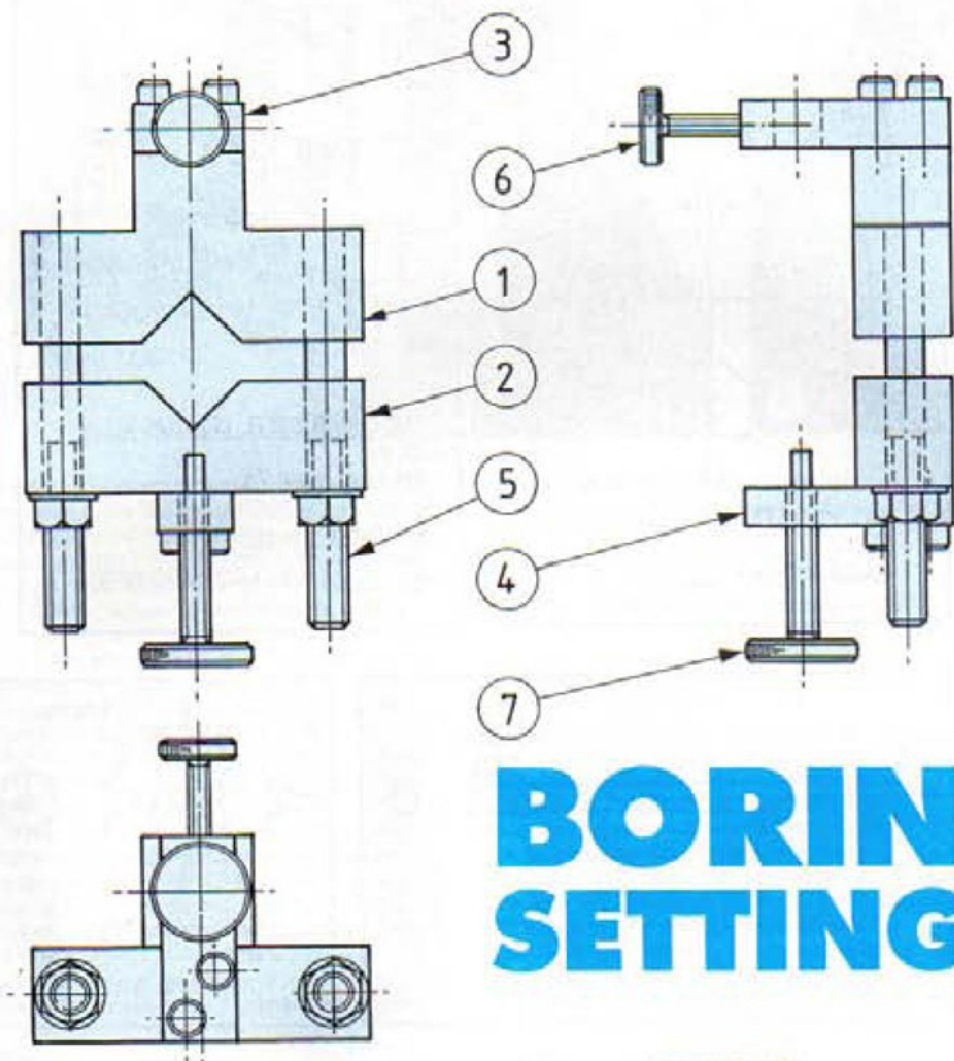


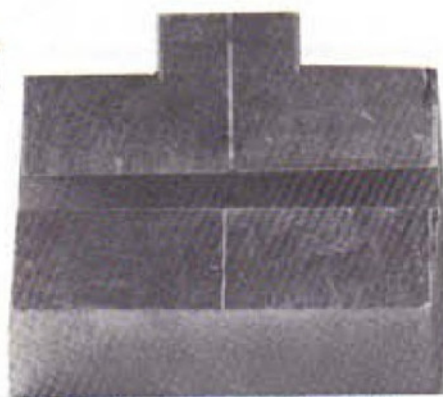
FIG. 2 SCREW JACKS IN USE



BORING BAR SETTING DEVICE



1



Boring holes in a workpiece which is mounted on the lathe cross slide, by the use of a boring bar between centres is a common operation in the home workshop. Even so, many operators have found achieving a precise hole size far from easy due to the rather hit and miss method of setting the cutter in the bar. This neat little device provide by Eddy Rebbeck should totally eliminate that problem

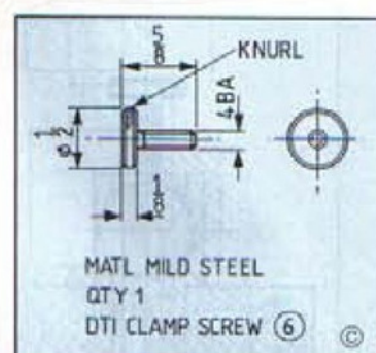
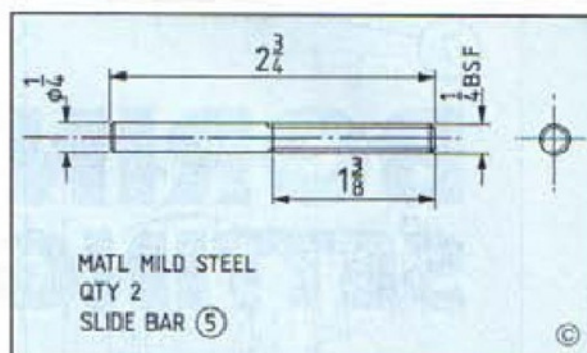
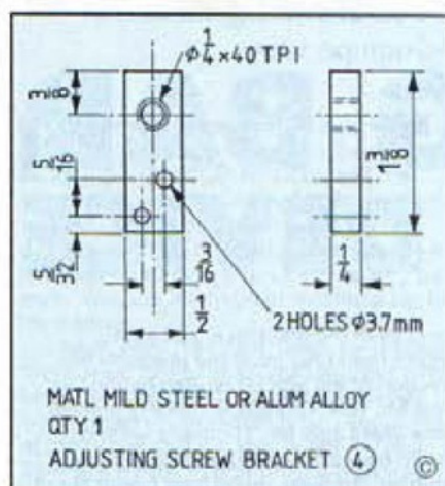
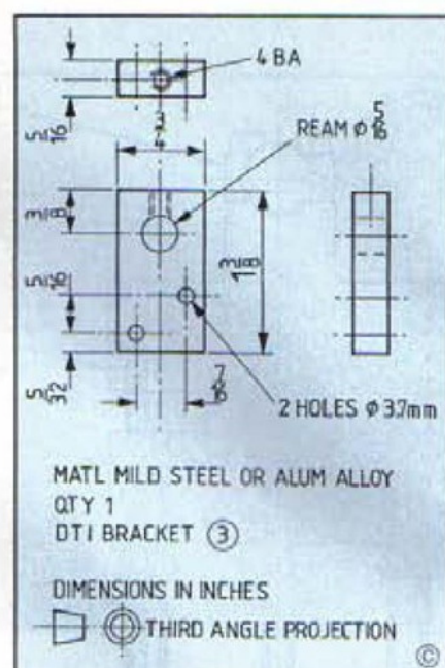
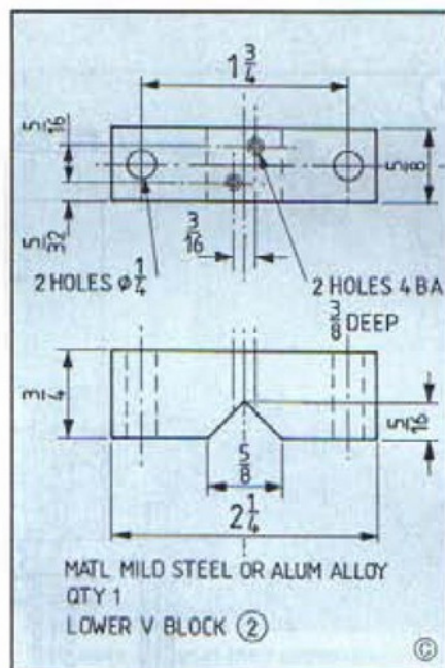
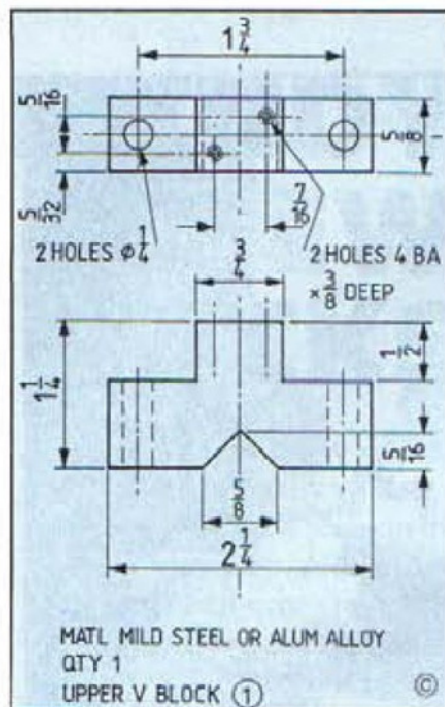
How does one bore a hole in a job bolted to the lathe cross-slide, using a bar between centres, and end up with said holes the correct size? Not easy for an old coal miner, or anybody else come to that! The first problem is to measure the thing; a Vernier or Dial calliper, used carefully, will give reasonable results even in unskilled hands. However, the real problem is that once the screw that holds the cutter is slackened, one enters the realms of guesstimation; or at least that was the case before I dreamed up this little gadget, which seems to have solved the problem completely.

It ensures that the position of the cutter bit is at all times under precise control (at least in amateur terms), and allows for the bit to be removed, re-ground and replaced in the exact original position. The secret is in the use of a Dial Test Indicator (D.T.I.) to monitor the cutter position. I have proved to my own satisfaction that it works every time. Of course, the cutter has to be ground

correctly in the first place, and in this respect I can only point the reader in the direction of the articles written by the late, great Mr. G.H. Thomas in *Model Engineer* some years ago. Mr. Thomas's writings should be read by every aspiring amateur engineer. Anyway, this is how I went about this job.

The material

The first job was to find something to make it from, mild steel would do, but I found a rough lump of aluminium alloy, a relic of the heady days when I attended evening classes at the local Tertiary College, where we could make our own castings. From this lump I cut a piece 3 x 3 in. and about 3/16 in. thick. This was set in the four jaw chuck and machined to 1/8 in. thick. The block was then cut into two pieces, comprising a rectangular bar about 2 1/4 x 3/4 x 1/8 in., the other T shaped, as shown in the drawings and **photograph 1**. I used a bandsaw to cut the bits approximately to size, although it would have been almost as quick to have used a hacksaw. The four jaw chuck was again used to machine the edges of the pieces, so as to have faces and edges square to one another. The T shaped piece was finished by clamping it in the vice on the vertical slide, and operating on it with an end mill held in the three jaw chuck (**photograph 2**). At this stage the aim is just to square things up. Next job was to mill a V groove in both pieces, after first coating both with marking blue and using a good sharp scriber, putting in a clear centre line, on the face that is up when both have their 2 1/4 x 3/4 in. faces butted together. The V grooves are then marked either by using a protractor, or simply by

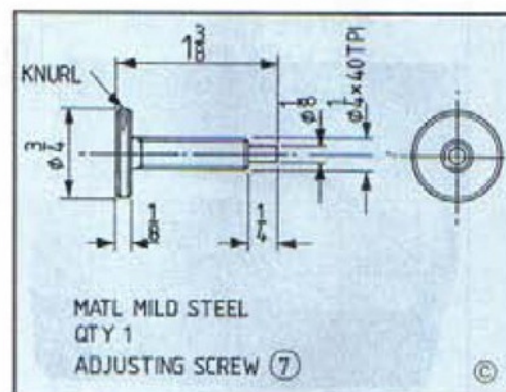


measuring $\frac{1}{16}$ in. each side of the centre line and drawing a line from there to a point $\frac{1}{16}$ in. up from the edge of the blocks. The lines are only there to give a rough guide when setting up for the next operation, which is to mill out the grooves. To do this I again set up the vertical slide, setting it square by running it up to the lathe faceplate, put on for the purpose. Next bolt the machine vice to the slide, with the fixed jaw set horizontal. Each block is then clamped in the vice with the marked-out face uppermost, and sanded round so as to present the $2\frac{1}{4} \times \frac{1}{16}$ in. face at an angle of 45deg. to the faceplate. To do that you can use an ordinary school type set square with one of the right-angle edges against the

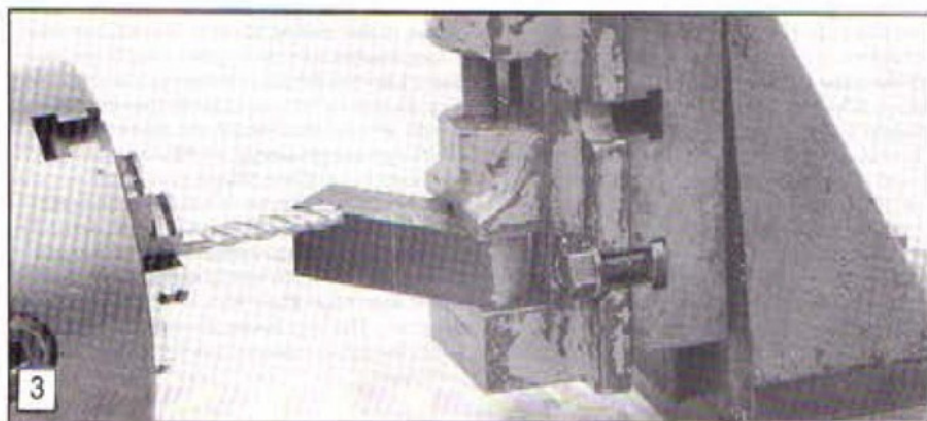
faceplate, and the 45deg. edge against the face of the block. It all looks very insecure, but we shall be taking light cuts only, so it will work out OK; **photograph 3** shows the work at this stage. The bulk of the waste could be sawn out, leaving less to remove with the end mill, but as there is not a great deal to remove, either method would serve. I used a $\frac{1}{16}$ in. end mill for this job, but a home made one, as advocated by the late LBSC would do as well. I kept cutting until I just split the lines; the corner of the cutter then ends up on the centre line. Please remember, light cuts only.

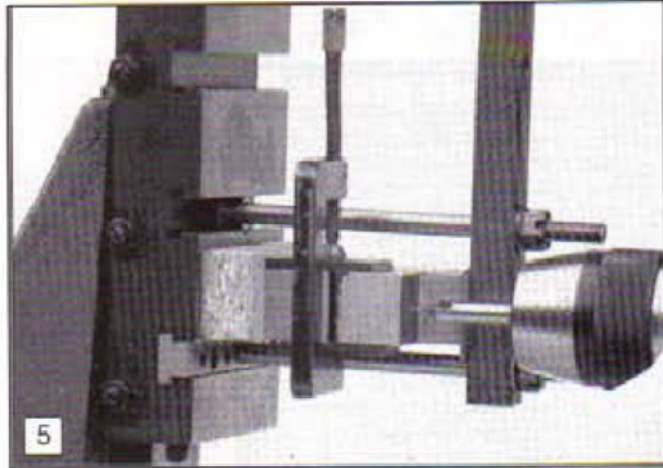
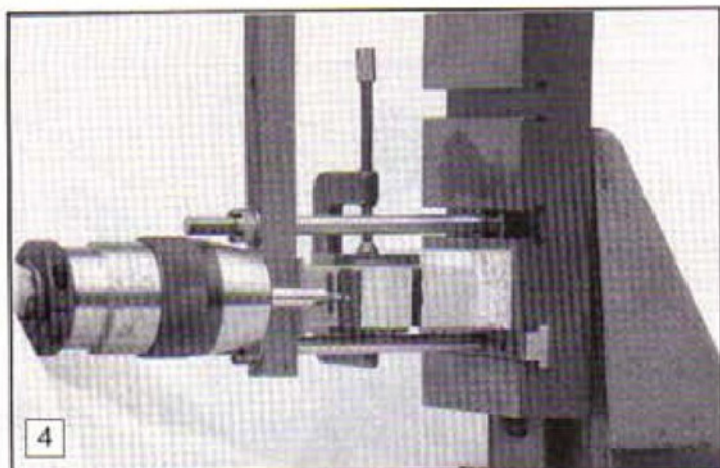
Both blocks now have to have holes drilled to take the guide bars; these must be in the right place so that the blocks will line up nicely. The important thing is to get both Vees and the guide bars fitted so that in use the smaller block will slide easily, and both Vees line up accurately.

The method I used was as follows. First I cut a short length of $\frac{1}{16}$ in. square steel,



about 1 in. long, and placed this in between the blocks, resting in the Vees to line them up with each other. Both blocks were then clamped to the face of the vertical slide, with one leg of the T facing the chuck. Before clamping up tight, I placed a piece of Melamine faced board between the job and the slide for the drills to run into without damaging the slide. Get the blocks as level as possible across the lathe, that is parallel with the cross-slide. Now the object is to end up with holes that are a nice sliding fit on the bars. The size of these depends to a great extent on the material chosen, you can use posh stuff like ground steel, or ordinary MS stock. It depends on what you have but MS is perfectly OK for the purpose. It is not even necessary to ream the holes. I used metric drills, creeping up one increment at a time until I achieved a nice sliding fit. When aiming for a reasonable fit on jobs like this, I find that





the small size increments in the metric range of drills is a great help, as by starting well below the needed size, I can gradually open up the hole until I get the size I want. Not all of us have drills which leave us with the right size hole! **Photographs 4 & 5** show this job in progress, **photo 4** from the front, **photo 5** from the rear and as you can see, the clamp holding the job to the vertical slide is just a piece of steel with two holes for the clamping bolts. There is also a clamp bridging both alloy pieces, to line them up with one another, the object being just to ensure a reasonable appearance in the finished job. The only other point worth mentioning is to start drilling with a centre-drill, preferably one of $\frac{1}{16}$ in. dia., which, entered just until it cuts the full diameter, will afford a good start for the drill to follow. I found it best to use a keyless type chuck plugged into the hole in the lathe mandrel, as it is less bulky than a Jacobs, and I could see what was going on. A piece of the material to be used for the slide bars can be used as a gauge to get the hole sizes right. In my case a final drill size of 6.4mm (which is just over $\frac{1}{16}$ in. = 0.252in. - Ed.) gave a nice slide fit.

The guide bars themselves are just two lengths of steel, 2 $\frac{1}{2}$ in. long with $\frac{1}{16}$ in. of $\frac{1}{16}$ in. BSF thread on one end; and faced off flat at the other. As shown, these bars are fitted into the T shaped bar, in my case using Loctite 601, which is my preference for this type of job.

On the subject of the clamping bars and the V blocks, the sizes are such that a 1in. boring bar can just be accommodated, which is ample for my needs. If you may need to use a larger bar, I suggest that not only do you increase the length of the clamping bars, but that the Vees are enlarged as well, making the sides $\frac{1}{16}$ in. instead of the $\frac{1}{32}$ in. specified.

Once the Loctite has cured, clean off the bars and blocks, making sure there is no adhesive left to cause problems, and fit them together with a couple of nuts and washers ready for the next job, which is machining the faces and edges of the blocks to a nice finish. This is a four jaw chuck job, but be sure to protect the soft alloy with some kind of packing. I use short lengths of aluminium strip, about $\frac{1}{4}$ x 1in., bent so that they clip onto the chuck jaws and so stay in place. I find this is better than trying to use loose bits, and I only need one pair of hands!

Next parts to make are the brackets fitted at each end. Both are 1 $\frac{1}{2}$ in. long, but one is $\frac{1}{16}$ in. wide x $\frac{1}{16}$ in. thick, this one to hold the D.T.I., the other is $\frac{1}{16}$ in. wide by $\frac{1}{16}$ in. thick, this one carrying the adjusting screw. I made both brackets out of some

odd bits of aluminium alloy, and flycut them to shape, whilst they were clamped in the lathe toolpost. As you can see, these brackets are secured by a couple of 4BA screws on each bracket. I think the best way to go about fixing the brackets to the V blocks is to stick them in place with Superglue, taking care to set them in line. Just put a couple of scribed lines on each V block where the brackets are to go, then glue them in place. Once they are settled they can be centre punched and drilled, (tapping size for the screws you intend to use) through the brackets and into the blocks. Normally it is possible to release the bond by giving the brackets a sharp sideways tap. Open the holes in the brackets to clearing size. I suggest leaving the holes for the adjusting screw and the D.T.I. until the brackets are fastened in place. Both can be marked using a scribing block on a flat surface, then both holes will be in line. A piece of Formica topped chipboard, used as an extemporised surface plate would be quite flat enough for this job. I also marked the position of the hole for the screw that clamps the D.T.I., and in this respect you may notice a slight difference between drawings and photographs; either position would serve. The difference occurs because I made two. This screw, by the way, should not be too big, as the D.T.I. is held by clamping on the stem, and if clamped too tightly the plunger will stick. In my case the adjusting screw has a 40TPI thread, which gives a nice "feel" to the process of moving the

cutting bit. The screw clamping the D.T.I. is 4BA with a knurled head.

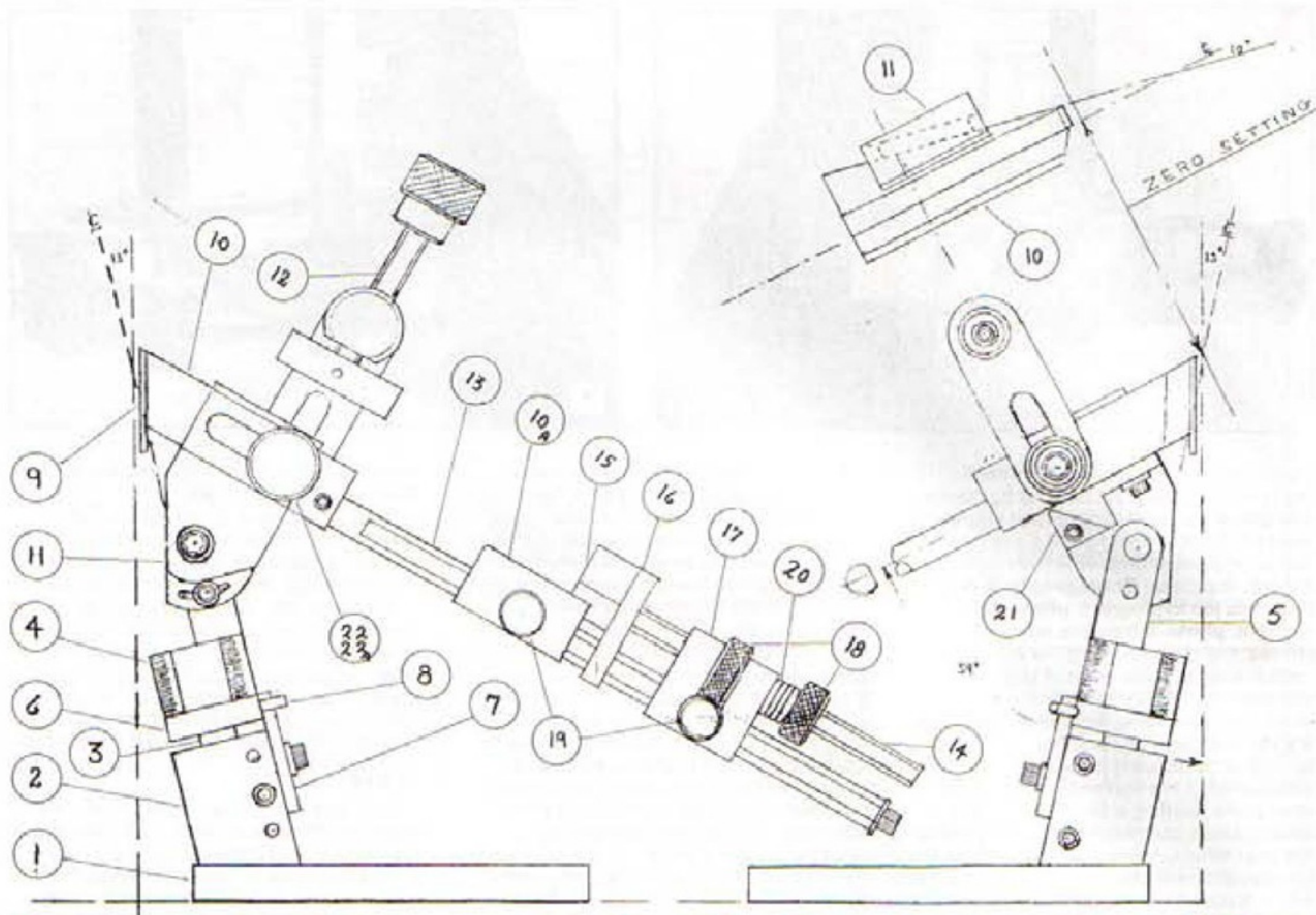
This, as opposed to hexagon or other type of head, helps to ensure the clamping process is not too severe, which could make the movement of the plunger too erratic.

For those who work in the metric system, all the measurements could be changed to millimetres, just keeping the proportions about right. There is nothing magic in any of the dimensions, or about any of the threads used. Just use whatever suits you. The important thing is the concept.

In use

That just about wraps it up I think. The use is pretty obvious, the only other thing I can think of is that the end of the plunger on the D.T.I. needs to be flat, i.e. not fitted with the usual ball end. This can be made quite easily from silver steel with one end turned down and threaded. My D.T.I. uses 6BA; but check your own to be sure. The other end is faced off flat. When using the gadget I slide the D.T.I. into its holder until the hand goes round the dial once, to load the spring, and make a note of the reading, then I know I can always get back to the same place. From then on it is just a matter of releasing the screw clamping the cutter, and adjusting with the 40TPI screw, whilst watching the hand of the D.T.I., easy! I know it has been said before, but I really don't know how I managed without it, with careful use of a dial calliper, I find that the results are excellent. I hope that you will think the same. Good Boring.





DRILL GRINDING

GEOOMETRY

Following the letter from Anthony Walton, regarding drill grinding geometry and published in *Scribe a Line* in issue 20, a number of interesting replies were received. This brief article from F. Fallows, was established as a result of producing a drill grinding attachment for the Worden Tool Grinder. It is particularly interesting

It is a constant request from members of the model engineering fraternity, for an article or guidance in the way twist drill grinding should be carried out, and in particular, could some insight be given as to the basic geometry that could be applied by those wishing to further their interests and skills, in what would seem to be a mystic world to many who are not trained engineers but who take up the hobby as a pleasant past time, and because of the friendships which develop along the way.

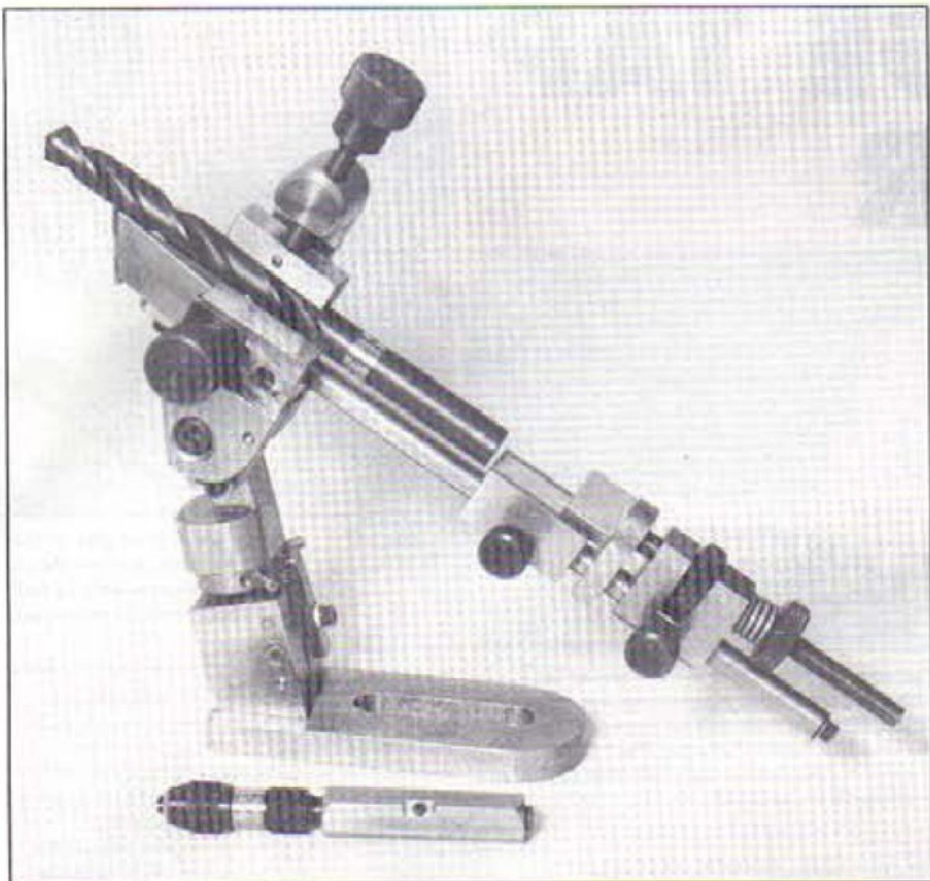
In putting pen to paper I do so not as an expert in this particular subject, but as one who has pursued an in depth study and research just out of interest. I have to say that I was trained as an engineer, and spent many years in the industry. Grinding drills was one thing we were taught as apprentices, and I pride myself that I can still do this magic by hand. So arising out of many requests from friends and model engineers I see at various meetings, the decision to make a jig to perform the job was taken.

To commence with let me outline my research in the beginning.

1) A paper written by Mr. L.A. Van Royen, was acquired. This had been published in *M.E.* August 1913, and gave a detailed mathematical analysis of the constructional requirements. Unfortunately an appliance of this kind was not readily made up in an experimental form suitable for carrying out a practical test of the correctness of the theoretical data supplied.

2) It so happened that another correspondent gave a reference to an article written by a Col. H.S. King, and was published in *M.E.* October 1927. This states that a jig described by Mr. Van Royen, was later produced and was tried out on various drills sizes $\frac{1}{8}$ in. to $\frac{1}{2}$ in. and were ground on a 4in. dia. oilstone wheel, mounted on the lathe mandrel. The writer goes on to say that small size drills gave satisfactory results, but the larger drills left much to be desired due to the wrong form of back off.

3) "Duplex" wrote an article in *M.E.* 15 November 1963. This covered all that I have said above, but went on to show how to make a Twist Drill Grinding Jig. This was an excellent article and one which gave me



the inspiration to go forward and make a jig for myself. The main points I was able to ascertain from the article was that "Duplex" had found that the geometrical configurations put forward by Mr. Van Royen, did not work out in practice, and went on to make adjustments that proved satisfactory, to which I concur.

4) A selection of Industrial Trade Machines were looked at, and I was impressed by the designs and the various approaches in achieving the same end. The costs of such machines was in hundreds and thousands of pounds which puts such equipment out of range for the model engineer, who at best will only want to grind his drills as required, and which rules out such capital outlay. A jig, as seen in **photograph 1**, and the general arrangement drawing, produced to the relative corrected criteria, has proved to be very successful and would seem to meet what the model engineer could be looking for. Drawings and Instructions along with a Kit of Material to produce the Jig is now available from N.S. & A. Hemingway, 30 Links View, Half Acre, Rochdale, OL11 4DD (0706) 45404. This now forms part of the

ongoing build up of accessories of the new and popular Worden Tool Grinder.

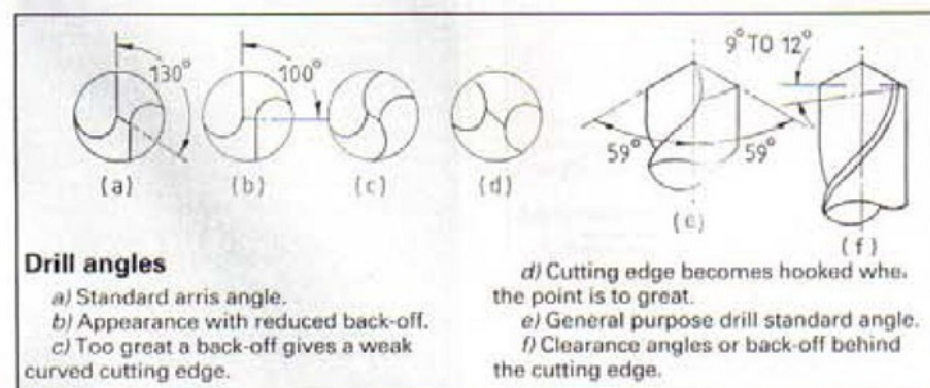
I trust you will bear with me whilst I show the basic fundamentals.

Data Put forward by Mr. Van Royen, was as follows:-

- a) Cone angle 26 deg. (Helix angle of flute on general purpose drill).
- b) Jig axis angle 13 degrees.
- c) Drill point to be forward of Jig axis set at 13 deg. by 1.4 times dia. of drill to be ground.
- d) Cone point is formed by drawing a line at right angle to the line of the drill axis set at 59 degrees, to a point which meets the vertical. The length of this line according to Mr. Van Royen should be 3 times the drill diameter. Questionable.
- e) Side displacement is equal to the drill diameter divided by 13 Angle of displacement 3 deg. 10 min. from above. Questionable.

Note

The nearer the cone axis is to the vertical where it crosses the drill axis line the greater will be the back-off produced.



Re-tang sleeves

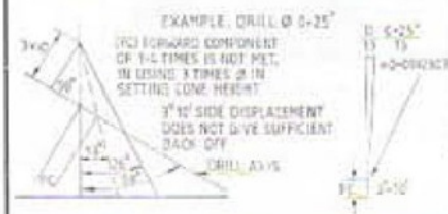
Morse taper drills or reamers which have broken tangs can be salvaged by re-grinding a new tang lower down and using special Morse taper sleeves called "re-tang" sleeves. The drift hole is in a different position and the reclaimed drills can be easily ejected with the drift. Beware though, as if a good drill or reamer is fitted in them it will be difficult to eject as there is no room to get the drift in. These sleeves are identified with an annular ring round the drift hole and the letter "R" before the size markings to indicate that they are for repair use only.

Alan Jeeves

Geometrical Representation:- Example 1

Data As derived from my research, was as follows:-

- a) Cone angle 26 deg. (Helix angle of flute on general purpose drill).
- b) Jig axis angle 13 degrees.
- c) Drill point to be forward of Jig axis set at 13 deg. by 1.4 times diameter of drill to be ground.
- d) Cone point is formed by drawing a line at right angles to the line of the drill axis set at 59 deg. to a point which meets the vertical. The length of this line according to my trials and Geometrical layout should be 4 times the drill diameter.
- e) Side displacement is equal to the drill diameter divided by 4. Angle of displacement is 10 deg. from the above.



Geometrical Representation:- Example 2

The forward component is adjusted by the drill diameter applied to a caliper placed below the jig's sliding drill cradle, as shown below:-

The angle of the caliper to give the required forward component is calculated in the following way.
 $\text{Sine } a = C = 0.5 \text{ in.} = 0.7142857 = 45 \text{ deg. } 35 \text{ min.}$
 $A = 0.7 \text{ in.}$
 45 deg. for practicability



A LARGE TAP HOLDER

The need for a large tap holder is likely to be a fairly rare requirement in the home workshop, perhaps not justifying the expense of purchasing one. This effective, and very easy to construct, tap holder, suggested by E. Powell, will be economical to make. The design is not restricted to just the larger size taps, its dimensions could easily be reduced for smaller sizes.



Start by making the radius on the end of the handle. Do this with only a short length projecting from the chuck.

The problem

It was some time ago that I came up against the problem of having to use quite a large tap for cutting a thread into a predetermined hole in a piece of equipment. Thinking back, I think the tap was of 3/4in.



Turning the taper, this is perhaps as far as one can go without supporting the outer end. Only light cuts will be possible, but making the taper shallower than that shown in the photograph will help to make the handle more rigid.

dia. (this I was able to borrow). Looking at the tap holders I possessed at the time, they were all designed for small taps and not the monster that I was about to use.

Not fancying going to the expense of purchasing a large holder for this one job alone, I first tried using a Mole wrench, snapping it tightly onto the end of the tap. This worked after a fashion, but was not really successful since putting pressure on the tap, and attempting to turn it at the same time, made the tap tilt at an alarming angle instead of running truly into the hole being tapped. "What next?" I said to myself, "let's try a toolmaker's clamp" was the answer. This was a little better as it was possible to keep the tap running fairly true, but it eventually reached a stage where not enough leverage could be exerted to keep the tap cutting.

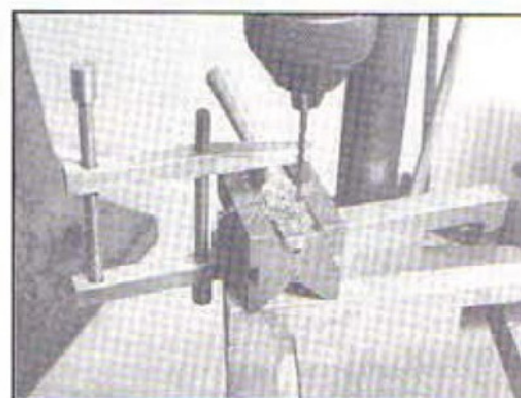
The solution

I was at the point of giving up when I decided to make a holder of the type

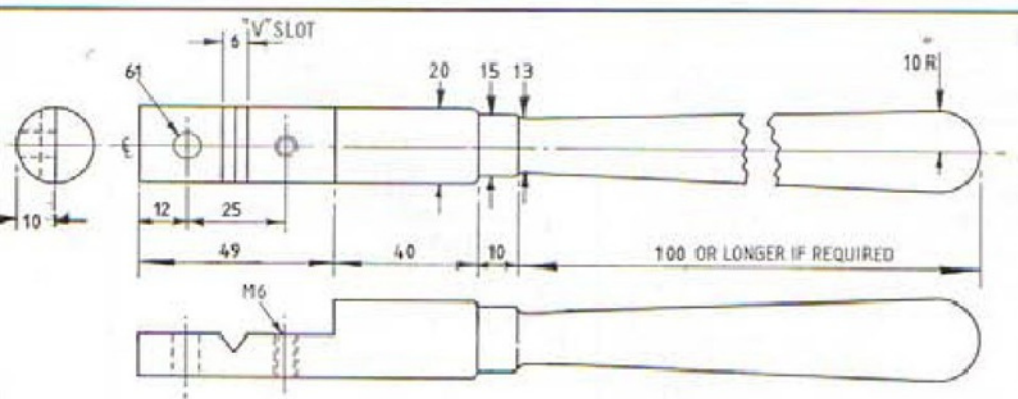


Milling the flat on one of the two handles, ensure this is done as precisely to half diameter as can be achieved.

described in this article. It is very easy to make, particularly in its simpler form, and I feel will be of help to others who find themselves with the tapping of large holes as an occasional requirement. Making a thread with a large tap can require a considerable turning force, and should the holder as drawn still be unable to provide sufficient leverage, lengths of tube could, in an emergency, be placed over the handles so that it can be increased.



Mark out and drill one half only using tapping size drill for both holes.



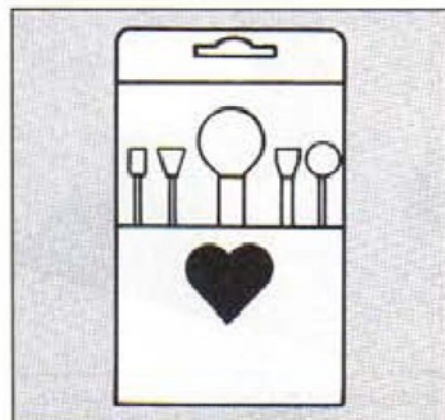
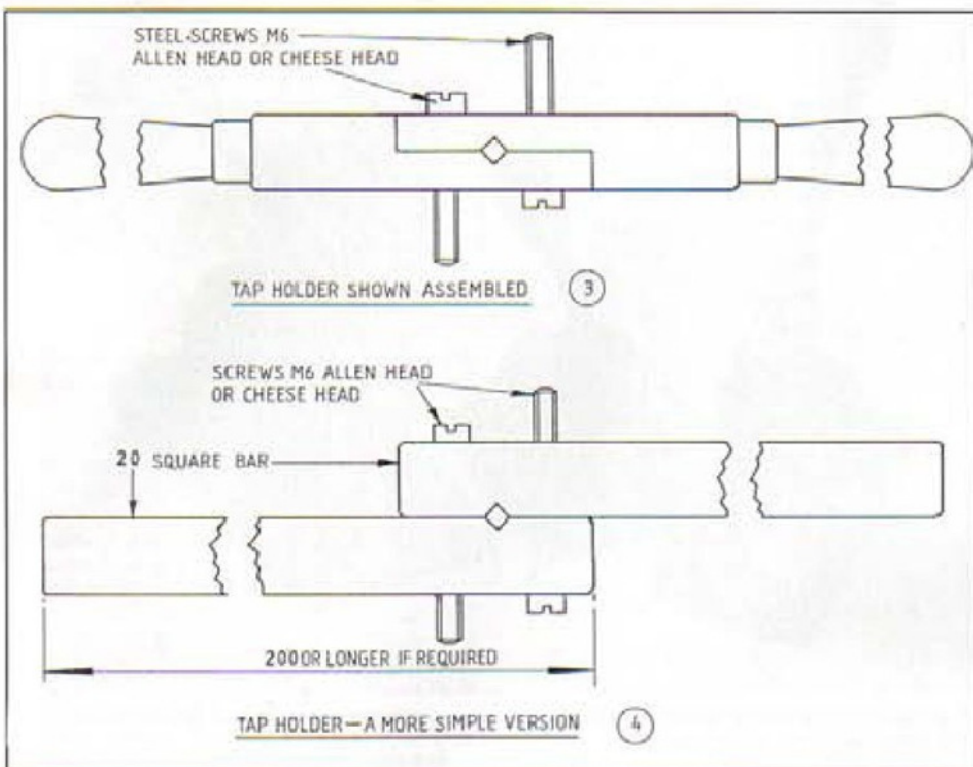
MATERIAL: 20# BRIGHT MILD STEEL
TAP HOLDER HALF: 2 OFF REQUIRED.

LARGE TAP HOLDER

USING MARKING OUT FLUID

Clean the metal surface to be marked. Methylated spirit and wipe dry. Avoid touching the cleaned area with your fingers. Next apply the blue with a clean cloth wiping from left to right (or vice versa) in several passes but not going over the parts where the blue has already been applied. (If the blue is applied with a brush, it will tend to be thick in some areas and will flake when the scriber is used). When marking with the scriber only pass this once over the blue layer. Strongly resist the temptation to go over the same line twice. All this will result in a neater marking and better accuracy when machining.

Anton Vella



PLASTIC ENVELOPE OF BRUSHES

Tucked-away amongst the cosmetic shelves in "fifty-pence stores" is a small yellow folder with tuck-in clear plastic lid containing four useful brushes together with a polystyrene dabber. These can be most useful for applying metal colouring, grease, coolant, flux, oil, swarf from lathe slides; cleaning the leadscrew, etc. all for just 50 pence. Now, when invited you have a valid reason to go shopping! Mine have proved most useful. Perhaps I should have spent a quid!

Roy Clarke



Carefully align two halves and clamp together. Drill through one into the other again using tapping size drill. Separate, tap and open up holes as appropriate.

Making the holder

Making the holder is really quite straightforward but, for the beginner to the hobby, the photographs show the main operations and the captions give some guidance.

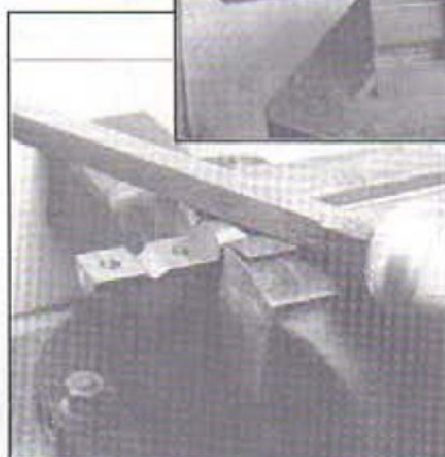


Set up one half in the vee block as shown.



Using the screws eventually to be used, clamp the two halves together. Support with second vee block and drill a suitable size hole where the square for holding the tap is to be.

the holder shown in the drawings made from square bar is a possibility. This will be able to be made much more quickly and, whilst more cumbersome, heavy and not so pretty, still will work quite well.



Separate the two halves and, using a square file, file the vees required using the hole just drilled as a guide.

Alternative designs

In the main drawing, the arms of the holder are shown tapered so as to give a more pleasing and professional appearance, but if preferred the constructor may leave these parallel for ease and speed of manufacture. For those who are in a real hurry because time is in short supply, then

Conclusion

The holder worked well and was an interesting little project; not least it saved some expense. It is a design that could easily be scaled up for even larger taps or, more probably, scaled down for smaller taps. In this respect the holder seen in the photographs is in fact about 1/3rd size, being made from 12mm diameter material, and works well with taps at around M10 size. There is no reason why the design should not be used even for quite small holders.





A close-up of the embossing tool which forms the conversion project in this article.

John Jennings suggests making a small staking tool by modifying a small embossing press, these are often available very cheaply secondhand

Some fifteen years ago I bought a letterhead embossing tool, the sort of mini-press that produced addressed note paper. I had a vague idea that I could make something out of it and indeed did have a half hearted attempt a year or so later.

Recently I have bought similar tools at car boot sales. I have seen a selection for sale from 50p upwards. Some of the older models are very beautifully decorated with gold transfers and are more expensive; as collectible items it would be a pity to destroy these. Three examples are shown in the photograph and there are many shapes and sizes available. In terms of being raw material for toolmaking two basic types exist: those made of cast iron and those made of zinc or aluminium alloy castings.

For some purposes the strength and mass of cast iron may be essential; for others the lighter metals that machine more easily will be adequate.



A group of three typical embossing tools. The two on the left of the picture are cast iron, the third has a zinc alloy base.

A SMALL STAKING TOOL

A small staking tool

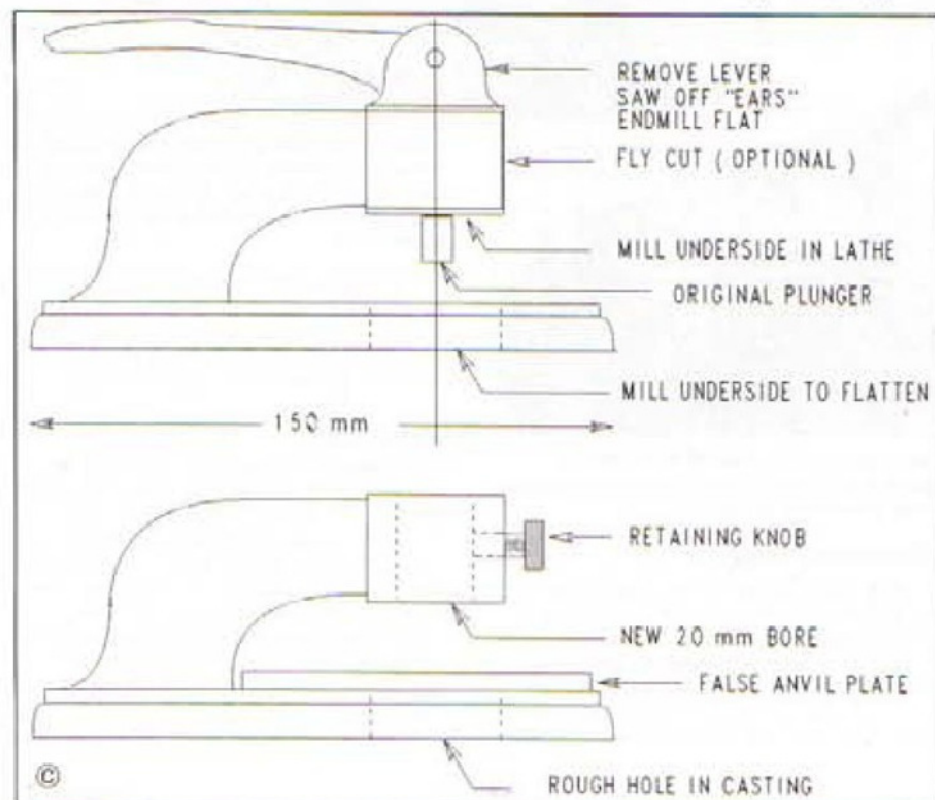
The staking tool is a device to enable the alignment of punches, workpieces and anvils. Small ones were essential equipment of the mender/maker of mechanical clocks and watches. A larger size staking tool/mini drill was described by the late George Thomas in *Model Engineer* some years ago and the book containing the reprinted articles is a useful source of reference for those interested in this type of tooling.

The instructions can, in the nature of things only be an indication of how to proceed and the pitfalls that might be avoided. It should be possible to adapt them to your own selection of embossing tool.

My starting point is seen in the photograph, it is made of cast iron (the black paint and union flag are a Jubilee Year repaint). The throat size is about 1in. high and just under 3in. deep from the front of the arm. Having looked at a number of examples this tool was a little unusual in that the operating mechanism was a round plunger about 1/4in. dia. actuated by the lever. Although possibly masked by several coats of paint you will find that cast iron embossing tools are very far from the state of the art castings available to model engineers, in short they are pretty rough, with surface defects and an absolute minimum of machining. This is shown in the photograph of the finished tool taken before repainting. I also had some trouble drilling the base plate, of which more later.

Initial machining

The only areas originally machined were a minimum on the top of the base plate, very far from all over, and the bore for the plunger. I did more machining than was strictly necessary to explore what was possible. A plan of attack is shown in the "before" drawing. First step was to remove the operating lever and associated bits and then saw off the bulk of the "ears" on which the lever pivoted. The base was then cleaned up with a coarse file (the manufacturers' solution to the base's flatness is a strip of thick green baize!). The casting was then bolted down on the

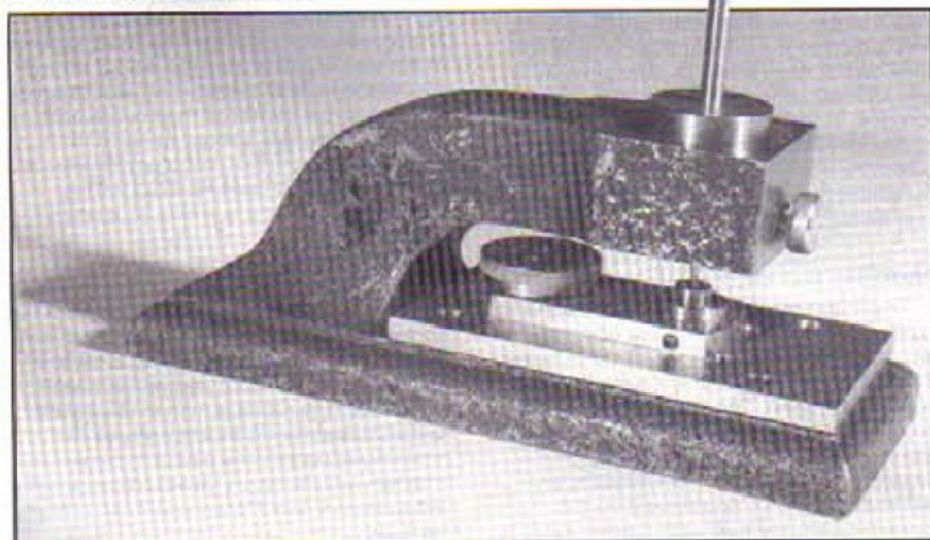




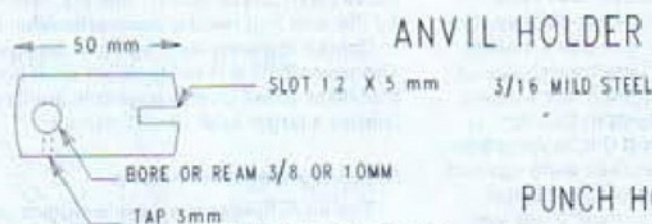
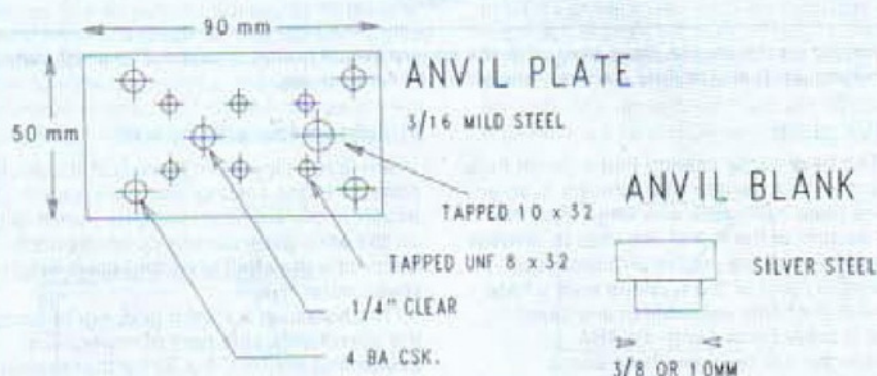
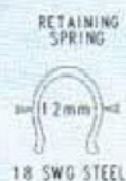
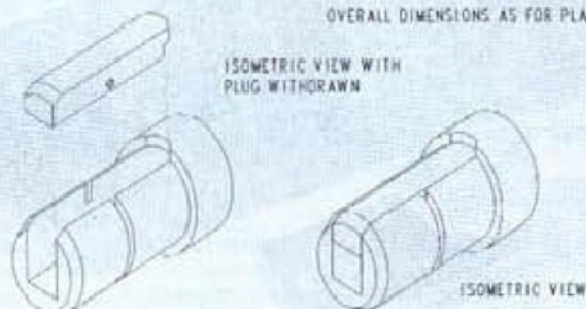
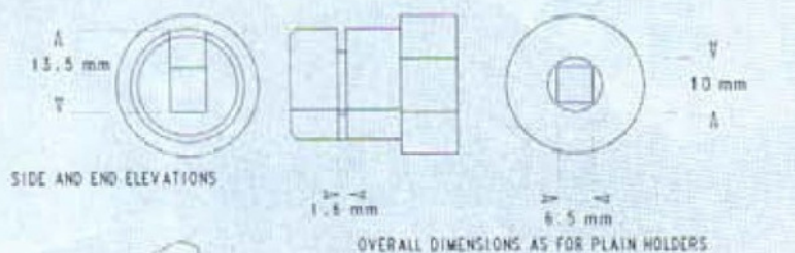
The three punch holders and a selection of unhardened punches.

milling machine table (an Emco 5 mill/drill and table) and the top of the casting milled flat, an extra 2mm was machined off to remove a chipped edge on the front of the arm and then the recess on top of the casting cleaned up and left as a slightly over square recess about 4mm deep, this might be useful but it does retain some stiffness that would otherwise be lost. The bottom of the casting was then machined by bolting the casting upside down on the now machined top surface. Light cuts, with an end mill, were needed and I only continued until about 75% of the base was surfaced, the casting sits firmly on a flat surface without rocking and a vast amount of metal needed removing to clean up the whole surface. The remaining machining operations were carried out on the lathe, the added rigidity compensating for the inflexibility involved. To machine the underside of the arm, which ensures uniform clearance I bolted it on the Emco Milling table parallel with to the lathe shears and took light cuts with a 1/2in. dia. end mill held in a collet chuck. Obviously the cutting length has to be sufficient to machine the width of the surface in one pass. A tip here is to use several layers of 0.005in. shimstock as part of the required packing, removing these one at a time gives a steady rate of feed. The end face was flycut but it is probably not necessary to do so, apart from improving the appearance of the tool. The final and important machining operation was to open out the bore to make it parallel through its length. To do this it was bolted on to an angle plate and aligned onto a stub of metal, that fitted the original narrow

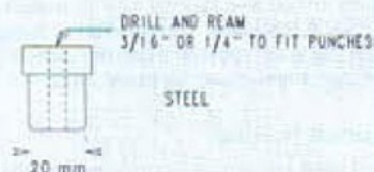
This 3/4 view shows the round punch holder in position. The punch is located in the hollow anvil, mounted on the anvil holder.



SQUARE PUNCH HOLDER



PUNCH HOLDER

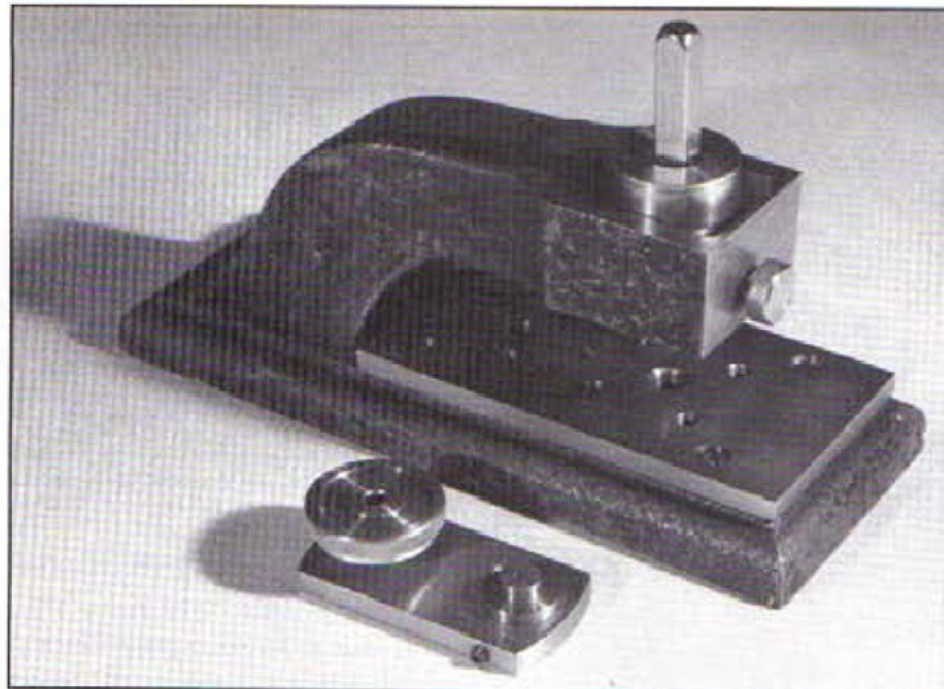


part of the bore, held in the lathe chuck. The boring was done with a single point boring bar, changing the HSS bit when the bore was large enough. The final size was exactly 20mm, a shade over the size needed to clean up the whole length of the bore. Providing you know the accurate size of the bore its actual size doesn't matter although it is less mental effort to turn a matching piece to a round number.

The end plate of my casting had a small tapped hole and this was used as the location for a brass retaining knob which has a 1/4in. x 32TPI thread. If you are drilling from scratch, position the hole in the centre of the face; my existing hole was rather low.

If you cannot obtain an original embosser with a solid end to the arm you may need to make a block to fit between the two parts of the arm and bore as you think fit.

When the project has been completed this part will need stripping, filling and repainting.



A variant on the theme, seen here with the square punch holder in place. The anvil plate, retaining knob and hollow anvil are shown in the foreground.

Anvil plate

The base of the casting had a rough hole about an inch square cast through it; so a cover plate $\frac{1}{2}$ in. thick was fitted over the flat section of the top of the base to provide a working surface (as the arm prevents access to most of the working area a false plate is probably essential in any case). This is bolted down with 4 x 4BA countersunk screws and here some difficulty was experienced. Although there were 3 existing holes tapped 6BA initial attempts at drilling failed. I am still not sure what the basic problem was, after making some progress with carbide tipped masonry drills I finished the holes with a long series drill with a custom thinned point. During all this effort the hole centres had drifted somewhat so they were opened out to 6mm and plugged with brass rod secured with Loctite. The brass plugs were then drilled and tapped 4BA to match the holes in the plate. The remaining holes in this plate are located from the punch holder; these must be made next.

Punch holders

These are simple turned items made from 1in. or $\frac{1}{2}$ in. free-cutting mild steel. Centre both ends and skim the ends of the blanks then turn down a 20mm length to 20mm (or your diameter if different). Taper 2mm of the end to aid entry into the hole in the arm. Reverse and skim the unturned surface.

Drill 4.7mm or 6.3mm dia. (check first to see if your drills cut to size) and ream $\frac{3}{16}$ in. and $\frac{1}{4}$ in. respectively or to any dimensions of your choice.

Punches

These are made from $\frac{3}{16}$ in. or $\frac{1}{4}$ in. dia. silver steel; for my staking tool cutting each 13in. length into four equal bits gave an adequate length. Face each end and taper the hammer end for 10mm or thereabouts. Turn the business end as required: solid, hollow, flat faced, domed etc (George Thomas is good on possibilities). You need one tapered punch with a point at this stage so you can finish the base.

All the punches will need hardening and tempering in the usual way.

Finishing the anvil plate

If it is not already in place bolt the anvil plate on to the casting. Secure a punch holder in the arm and mark the punch axis on the anvil plate using a pointed punch. Dismantle the anvil plate and mark out the seven other holes.

The holes, on a 20mm grid, are to accept the interchangeable bars of my jig/vice device and are UNC 8 x 32 for that reason. If you are not so constrained you could move them further apart, mine are overhung by the arm and need a short arm Allen key to tighten the securing cap head screws. The seventh hole is to clamp an anvil holder that takes small interchangeable anvils and I chose a larger UNF10 x 32 thread.

Anvil holder and anvils

The anvil holder is a simple slotted plate with a bored or reamed hole at one end. The small hexagon socket setscrew, which secures the anvils is about 3 mm x 0.5 mm.

The anvil holder is clamped to the anvil plate by a large knurled knob fitted with a $\frac{1}{2}$ in. UNF 10 x 32TPI set screw. Make it as fancy as you like or use a hexagon headed bolt and washer.

The anvils are short lengths of silver steel, a peg on one end is a close fit in the anvil holder, the other shaped as required. Again in general they will need hardening and tempering. As the anvils are locatable they do not need absolute concentricity. In use an anvil is fitted to the anvil holder, which is loosely attached to the anvil plate.

The anvil is then located using a suitable punch - a hollow anvil and a tapered punch for example and the fixing knob fully tightened.

Number punch holder

The initial reason for making the stake holder was to facilitate the use of number and letter punches. They work much better if held exactly upright and a suitable holder is now described. The smaller punches are notionally $\frac{1}{4}$ in. square but most of them are nickel or chromium plated and rather uneven plating makes them oversize and rather irregular. To accommodate the variation a square hole with 6.5mm sides is

required. To provide for the smaller punches, provision is made for spring loading the punch. The proper way to make the holder is probably to use a square broach the practicality is the cut and plug method adopted. I used brass for this item to improve machinability and to reduce the possibility that the workpiece would distort when slotted. Initial machining is as for the steel punch holders. While both centres exist cut a groove with a parting tool half way down the narrow section 3mm deep and $\frac{1}{4}$ in. wide. Drill the wide end 4mm to depth of 12mm and open up with a $\frac{1}{4}$ in. (9.5mm) end mill to a depth of 10mm (this is the depth of the collar) this should clear the diagonal of the punches. A 6.5mm wide slot is then milled into the workpiece. Use an end mill about 4mm dia. and check that the cylindrical cutting face is long enough to provide the depth of cut, it needs to clear the wider collar as well as the part being milled. You might need to substitute a longer wider cutter to finish the slot which will be about 13mm deep. Check both the width of the slot and that it is symmetrical about the centre line as you go - short pieces of 6mm and $\frac{1}{4}$ in. bar make useful gauges. Remember when you have cut into the top surface of the bar you lose the easy reference line for the depth of the slot. Note that the slot extends slightly into the wide part of the holder. Having completed the slot your next job is to mill/file a brass block to fill up half of the gap created.



A general view of the anvils and square punch holder

When shaped and fitted using a punch plus a slip of paper as a spacer/gauge. I found that Superglue was a satisfactory way of temporarily fastening this plug in which then needs cross drilling 1.6mm at the base of the slot. A slot is then cut with a slitting saw at the base of the existing slot to break through to the corner of the square hole. Ideally a $\frac{1}{16}$ in. saw should be used to reduce the amount of material removed a reasonably thick blade - 0.02 to 0.03in. should be used as it is acting as a small milling cutter.

Finally bend up a small spring to the pattern given, note that the ends are different. Remove the sharp edges from the end of the spring or it tends to jam. When the end with the less pronounced bend is hooked in the hole in the plug the "free" end should bear on a punch in the square socket. It is easier to fit and remove the retaining spring with a punch in place.

When all is working you can then pin the plug into position if you think it is necessary.

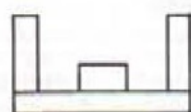


THE METHODS OF A PROFESSIONAL

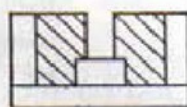
The request, in my recent article on bending practices, for some clarification from a professional on one or two points, has brought in this excellent short articles from Terry Gould. It highlights that so much of what is done in industry is equally appropriate to the home workshop

I read with much interest the article on metal bending (page 37 issue 20 of M.E.W.) and the bench press, and offer the following comments regarding my experiences in an industrial situation, hoping these may be of some interest. I do however mainly work in thicker material (3mm to 6mm) with fully auto Computer and Multi Numerical control press brakes, in a mass production environment. However, there are always the one offs, and whilst the Multi Numerical control press will accommodate these, it is much quicker to use the fly press or single ram oil press. Our Norton flypress is used quite extensively.

With reference to photos 15 and 16, in the published article, the bottom tool or die is a common sight in our workshop, albeit a little different in shape, mostly as illustrated in **sketch 1**.



BASIC BOTTOM TOOL OR DIE.



DIE WITH INSERTS TO REDUCE GAP.

ALL DIES ARE FABRICATIONS.

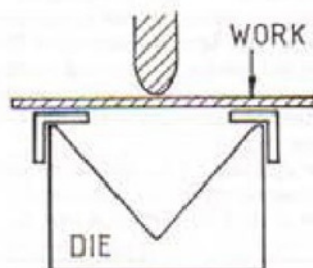
SK. 1

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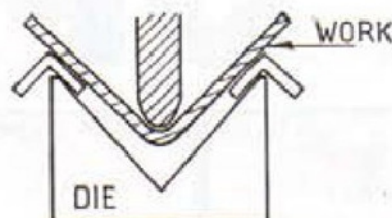
Our guide line as to the width of die used for a given thickness is 8 times the material thickness, for 5mm thick mil steel this would be 40mm width of the vee. This would be used with a punch having a 5mm radius for manual operations. The press brake uses a 60mm vee at 88 deg. for 6mm thick and a required angle of 90 degrees. In this case the punch radius would be 12mm,

this also with an angle of 88 deg., thus allowing 2 deg. for spring back.

We also have a method of achieving 90 deg. when it cannot be reached with a 90 deg. vee. This entails using two lengths of angle (pressed or rolled) about 25 x 25 x 3mm. The angles are put on top of the die as shown in **sketch 2**. This not only makes the material travel further, but will also narrow the die width at the top. This method is also used for one offs where the angle required is less than 90 degrees.



ANGLE ON TOP OF DIE SK. 2

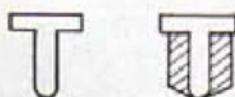


WORK HAS BEEN BENT TO 90° SK. 3

©

Sketch 3 shows that as there is an air gap under the work, the punch can travel further to bring the work to an angle less than 90 degrees. This method is also used with the rectangular section die in **sketch 1**.

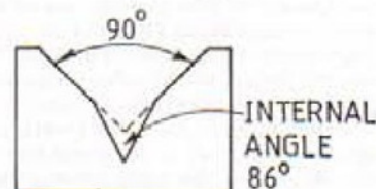
As with the die, the punch tool we use for one offs, or limited runs, is similar, a fabrication as in **sketch 4** is made to a range of sizes. The sketch also shows a punch with side plates added.



BASIC PUNCH SK. 4

©

The 90 deg. theory is as true, to a point, for us the model engineer, as it is in industry. Thickness of material, radius of punch, plus die vee width, all play a part, plus grade of material. Our listing for MNC press work for spring back up to 8mm thick in ST.45 grade material, is that the operator must add 0.145% for ever 10 deg. to the total angle required. Most of our MNC presses do this automatically. All our dies for materials up to 3mm thick are 90 deg., all others are 88 and 86 degrees.

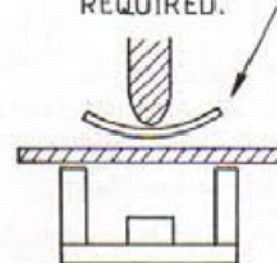


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SK. 5

We do use what we call Combi dies. These have two angles on one die as seen in **sketch 5**. These are used for material with a lot of spring back. It is not uncommon to have a channel machined in the bottom of the die and use a smaller radius punch as a secondary operation to bring the work up to 90 deg. or beyond.

PREFORM STRIP LENGTH OF WORK. THIS RADIUS IS MADE ABOUT 6mm LESS THAN THE INTERNAL RADIUS REQUIRED.



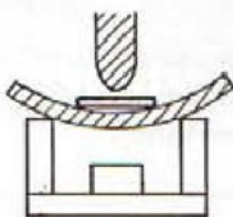
SK. 6

©

Also we use the channel section dies for forming large radii, for batch work we would have tools made, but for small quantities we pre-form a piece of steel as in **sketch 6**, the width of the die opening, this has to be thicker than the work. On thinner material (less than 6mm) in mild steel, deforming in the centre on the tighter radius can occur. For this situation a thick



SK.7



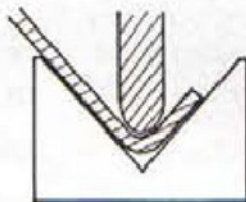
SK.8

© rubber cushion is placed in the bottom of the die. Another way is to start with a flatter strip, see **sketch 7**. Another method is to start the bend with a flatter strip. Using a flat strip as in **sketch 8** will spread the load, but one has to know when to stop. This can only be done by trial and error. The flat needs to be about $\frac{1}{2}$ the die opening.

The actual depression required is not very much, performing the task with 6mm workpieces by 300mm wide on a 60mm wide die opening, the amount of depression required would be about 15mm plus the thickness of the flat which would be about 6mm thick plus.

Using the largest die width will reduce effort but you have to be careful that it is not too wide for the leg length (leg internal dimension of bend) (A formula from another source indicates that pressure

required is proportional to material thickness and inversely proportional to the die width - Ed.) While the leg length may sit across the die it still has to be longer than the slope of the vee. If the leg length is too short for the die being used it will slide down the side of the die as seen in **sketch 9** and an incorrect leg length may result. This may also on the thicker materials put undue stress on the press ram or beam.



SK 9

©

Unhardened punches and dies

Having now also read the item in issue 21, in particular the question of unhardened punches and dies, the following comments may also be of interest. We also use unhardened punches and dies on all our presses, though the following comments relate to their use on the Norton flypress. Dies are made from 50mm diameter to fit the standard die holder, almost any grade of steel is used though we are supposed to use EN24, but one can never find a piece when it is wanted.

When the dies wear they are machined down to a given length and opened up to the next size. A packing washer is placed

Fitting drive keys

When fitting drive keys, in order to prevent them from 'picking up' due to steel to steel contact with the keyway, chalk dust can be dusted onto the mating surfaces.

Alan Jeeves

under the die in use to bring it up to the correct height. These washers are usually made from worn out dies. Dies can be re-machined more than once, they are about 45mm thick.

Punches are made in the same way from 1in. dia. bar. These are not re-used when worn out. For location a small centre pip is left on when being turned. Providing this is in the centre punched mark on the item being punched, and the mark is larger than the pip, the pip will last quite a time.

For centre location on longer batches, a needle from a needle bearing is inserted in the punch after a point has been grounded on it. The needle will not drop out, for after a few operations the punch will close up around it.

Useful in the home workshop

I do hope these practices from a professional workshop will be of help and interest to the home workshop reader. This should be so, as almost all would be equally applicable in the home workshop, albeit undertaken on thinner materials.



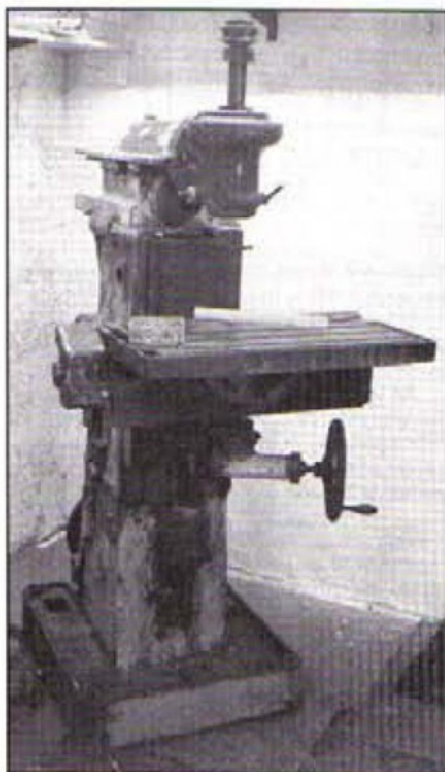
LINK UP

Reader to reader service - help
- queries - small sales - wants
- and it is all free!!



I have acquired an old universal milling machine. As with most such acquisitions, it came with little paint, much rust, some minor (hopefully) damage and no instruction manual.

The machine has two name plates. One is sited on the overarm and announces "Manufactured for E. H. Jones (Machine Tools) Ltd, London, By Sentinel (Shrewsbury) Ltd. The vertical head bevel box has a small plate with "Made by Optical Measuring Tools Ltd, Slough, England. Apart from a few minor instructions plates concerning feed and spindle rotation, there is only one other plate on the machine, a rather complex device indicating cutting speeds for various combinations of cutter and spindle speed. This is approximately eight inches square and mounted atop the main gearbox at the rear of the machine.



The only information I have is that an almost identical machine was manufactured by a company called Thiel (who copied whom) and that the beast is about 50 years old. It is in reasonable mechanical condition considering its age and neglect but unfortunately a few parts are broken or missing hence the need of Spares Lists, Instruction Manual, collets or any information.

I have good copying facilities available and any costs would be gratefully reimbursed or phone calls returned. Noble, 26 Councillors Walk, Forres, Morayshire IV36 0HA. 0309 672774.

Have acquired a Kerry Engineering metal lathe, 5 1/2 x 23in. centres model "C" which was marketed by F. J. Edwards, London N.W.1. I wish to obtain an operating, servicing, spare parts manual which hopefully would include screw cutting tables. Even a photo copy would be most welcome. Norrington, White House, Windmill Road, Bradfield, Manningtree, Essex CO11 2ON. Tel. 0206 393221.

A hone driver

If you have a cylinder hone an easy way to drive it at around 120 - 150 RPM is to use a power screwdriver (mine is a nominal 140RPM). A 1/4in. AF piece of hexagonal material soldered to the end of the shaft gives the drive and it is always ready for use.

Hugh Mothersole

Has any one any experience of cutting Imperial threads on a Viceroy 280 centre lathe fitted with a metric lead screw, and has any one got a dial thread indicator for the same. All and any information gratefully received. Tel. 0204 692454.

I need catalogues, brochures, sales literature and manuals for Aclera F1 and F3 and Deckel FP1 milling machines circa 1960/70s. Also require Horizontal arbor support arm for Deckel FP1. Phone 0903 770888 evenings.

Details of any modifications and enhancements to improve the Myford ML4 are of great interest to Chris King-Smith, on 0892 546059.

Help!! I have a Minox Oxykit brazing/welding unit which uses Hydrogen Peroxide of 130vols. strength to generate Oxygen at low pressure for direct use through its B.O.C. nozzle torch. The Hydrogen Peroxide, supplied in 5 litre containers is now impossible to obtain locally - does anyone know of an agent stocking the above? The Hydrogen Peroxide used as a bleaching agent by hairdressers is about 20 vols. strength, and is not suitable. D.A. Holman, Stileway, Gretton Fields, Nr. Cheltenham, Glos. GL54 5HJ. 0242 620379.

I need to purchase some Southbend or Boxford change wheels, plus a thread dial indicator for a Southbend C9W10JR 4 1/2 x 20in. lathe I am renovating. A complete set, or any odd ones no longer needed would help me no end, also any other suitable lathe accessories surplus to requirements (vert. slide, collet chuck etc.) which may be of use. Tel. 0473 689548.

I am interested in forming a model engineering club around the Newport/Cardiff area, with the idea of meeting other people with mutual interests and swapping ideas and help etc, meeting possibly once a month or every two weeks.

Also I would like to start up my own business locally supplying materials, tools, equipment etc and possible machining parts for other modelers. To my knowledge there is no one around here of such a nature and would welcome any ideas that you the reader may have as to whether you would use such a service. G. Matthews, 63 Laurel Road, Bassaleg, Newport, Gwent NP1 9PS Tel. 0633 892636.

Wanted! Manual of lathe operation and machinists tables for Atlas 5in. F series lathe, also address or telephone number for current Atlas spares stockists. Tel. 0934 517322

I would like details on plastic tool covering as follows, it is a liquid plastic tool compound used for pliers and is dipped into compound and allowed to cure. It is sold under various names like "Dip + Grip", "Plast-Grip", "Insul-X". These are American products and I wonder if there is a UK equivalent? Watson, 57 Oxbgangs Farm Avenue, Edinburgh, EH13 9PX. Tel. 031-441 1715.

Can anyone sell or lend an operating/maintenance manual for a Beaver Mill, Model VGRP, Series No 671. Any other info would also be appreciated. Would welcome a chat with another owner. Frank Tobin, 16 Penton Hook Road, Staines, Middx TW18 2PF. 0784 458928.

I was very interested to read your article on the history of the E.W. lathe (a recent acquisition and my only lathe). I would be very grateful for the loan of any handbooks for this lathe, or any drawings that would let me see how to fit a change wheel set for screw cutting. I will happily pay for photocopies. M. Kelly, Aldershot 0252 332714.

Wanted fixed steady for 10in. (5in. centre) Southbend, will buy, or exchange for Chesterman No369 height gauge 20in. with metric scale. Tel: 0322 288636 Wilmington.

Can anyone tell me where I can obtain redundant/reclaimed ball races, sizes around 1 1/4in. o/d - 1/2in. bore - 3/4in. or 1in. wide. All the sizes are not important. Also I would like 1BA or 2BA cap head, Allen screws and counter sunk around 1 1/2in. long screwed full length, about 72 in number. I have approx. 70 panel mounting switches for either exchange for the above, or would sell. Ring 0274 678455.

I have a Union 3 1/2in. x 20in. B.G.S.C. lathe. Can anyone help with a manual, change wheels, face plate or source of spares? 2 St. Thomas's Road, Cambridge, CB1 3TF. Phone 0223 249037.

Information required for Kerry 8-speed super drill, bench model, handbook, photocopy or original sought, or drawings/details of backgear arrangement. Tel: 0274 604767 (Bradford, W. Yorks) Holdsworth.

I need 2oz flat tobacco tins. Tel: 0322 330556 (NW Kent).

Wanted, two good condition, model 55 square-cut-thread jaw screws for a 6in. independent 4-jaw Pratt chuck. (Approx. 2 1/4in. x 1 1/4in. dia.). These have 3/4in. square key slots. Can anyone help please? Tom 0580 860366 (E. Sussex).

I am wondering if there is such an organisation as a Unimat Owners Club? There would appear to be a lot of interest in accessories, methods of usage, gadgets etc. I would willingly make regular contributions to a magazine if one could be organised, but at the moment I am too involved in another similar club to be totally responsible. 0469 532070.

FOR SALE

Many duplicate *Model Engineer* magazines for the years 1975/6/7/8/9/80/81/82/83/84/85/86/88. Will sell for £0.25 each but prefer to swap for 1960's, early 70's. Phone 0903 770888 evenings. (Sussex)

Jones & Shipman type 8146 Knurling Tool 1/2 capacity with medium and fine pitch knurls £40 inc. postage. Unused drawings for 5in. gauge Asia £10 inc postage. P.S. McMillan, 6 Delderfield Gardens, Exmouth, EX8 2DT. 0395 276832.

Toolmakers' cabinet, 4 drawers, lockable front, carrying handle etc, old and very sound. £35 plus carriage although prefer buyer collects (Essex) 0797 222217.

240 Volt A/C Parvalux motor with integral 40:1 integral reduction gear. Output is 33 RPM on a 3/4in. shaft (approx 1/4th HP). It measures only 3 1/4in. x 3 1/4in. x 6in. long. Condition is as new. £20 inclusive of p&p. 0962 880475. Winchester UK.

Sheet metal stakes £2.50 each. Full set unused, still boxed. Myford change wheels £45.00 Blacksmiths tongs and sets £2.00 each. Bolton tel: 0204 692454.

For sale very old anvil £50. Tel. 0767 313184 Biggleswade.

Drawing board on stand with parallel rule mechanism, £50; Mr V.V. Tucker, 22 Purday Court, The Avenue, Worcester Park, Surrey, KT4 7EN; 081 330 4125.

For sale. 6in. Pratt 4-jaw indi h.d chuck £30. 6in. Pratt 3-jaw s/c one set jaws £20. Plus carriage. Tel. 0322 330556 (NW Kent).

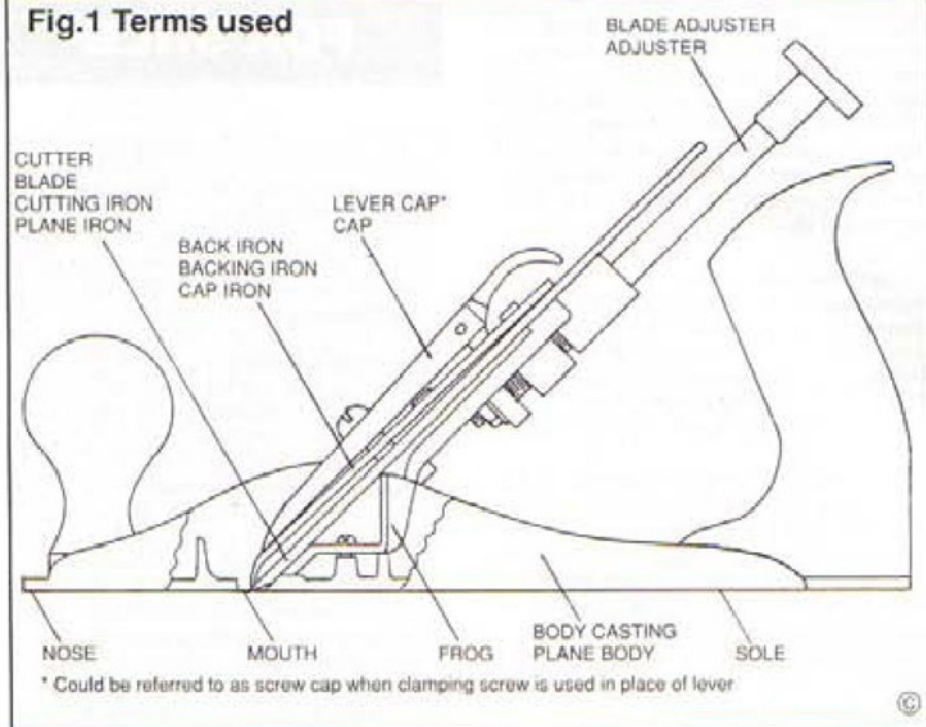
Unused copy of *Building the Allchin* by Hughes. For sale £11.00 including postage UK. D Harrington, 6 Townfoot Court, Carlisle Road, Bampton, Cumbria CA8 1SP.

Moore & Wright 1-2in. Braille Micrometer £35. Tom 0580 860366 (E. Sussex).

Having purchased Emco FB2 milling table I now have unwanted pedestal socket (new). This carries FB2 vertical unit for fitment to the rear of Emco £25.00. Also 3in. cross vice £12.50 p&p extra. 16 Whitehouse Rd, Claverham, Avon BS19 4LJ. Tel. 0934 838522.

Unused boxed set of three soft blank jaws for Burnard precision chuck models 130A and 130A. £20 inc. post. Tel. (lan) 0243 783704. (Chichester, W. Sussex).

Fig.1 Terms used



The design and use of the metal bench plane is an interesting topic, offering plenty of scope for the amateur innovator. As a user for many years my serious involvement began after reading a magazine article on the fine tuning of planes. This raised doubts as to whether I had been getting anything like the best performance from my own planes and set me off on a project which lasted over four years. Many aspects of this work will be of interest to metalworkers, whose skills and equipment are very appropriate to the techniques involved.

There would seem to be an opportunity for small business activity in this field. Many users may not have the time or the skill to carry out the work involved. **Fig. 1** shows the make-up of a typical bench plane and may be helpful to readers unfamiliar with the technology and terms used. Let's look at a few typical cases.

The 50p plane

Rather than experimenting with my own planes I looked around for a simple example with which to experiment. This turned up in pieces at a car boot sale in the form of a much-abused and neglected block plane. The 110 (**photo 1, Fig. 2**) was

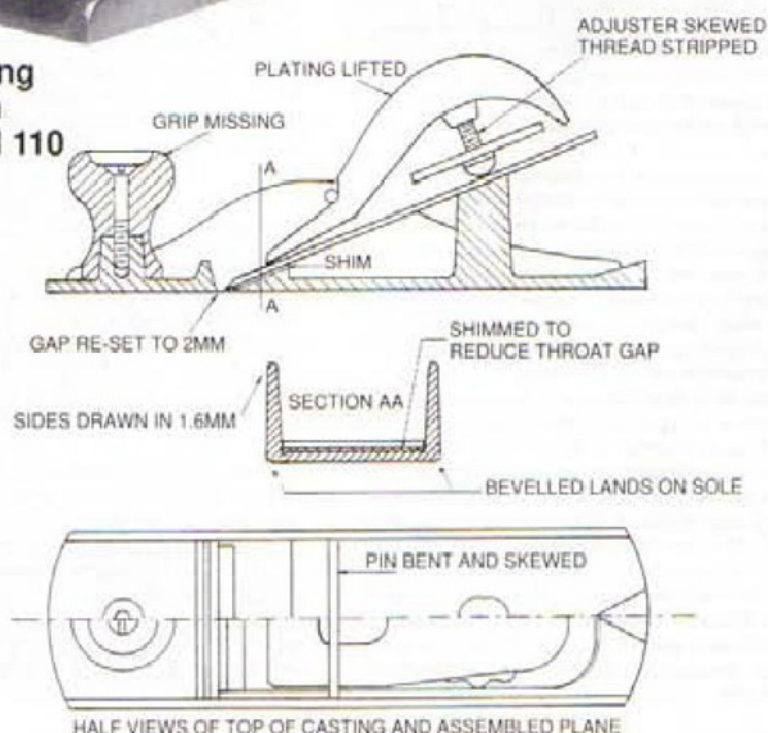
METAL BENCH PLANES

RECONDITIONING AND CONSTRUCTION



In this article, Peter Jones gives us another metal working article with woodworking connections. This time he describes his activities in reconditioning a range of bench planes. In some cases these have been well, or not so well used secondhand planes; in one case, he upgraded a new but poor quality economy plane. His attention to detail is very evident, even to weighing the metal dust removed from the sole of a plane and from this calculating the thickness of metal removed

Fig.2 Rescuing a much abused 110



badly rusted, its cap plating had lifted and the front grip had gone - it needed a friend after what had clearly been an unhappy life. When assembled its full range of disabilities became clearer. The clamping screw was skewed and its thread stripped, the cap pin was bent and misaligned in the body casting and the cutting blade had been damaged from hammering to set it forward. As to whether it had ever taken a clean shaving even in softwood was doubtful, little of the cutter had been used and the ground bevel progressively rounded by misguided attempts at resharpener.

I suspect the front grip had been shattered by attempting to use it as a strike button and, as more pressure was applied to the cap to resist ever increasing cutting force the clamping screw thread finally gave way. It then looks as if the plane was left in a garden shed to rust until the owner's effects were eventually cleared.

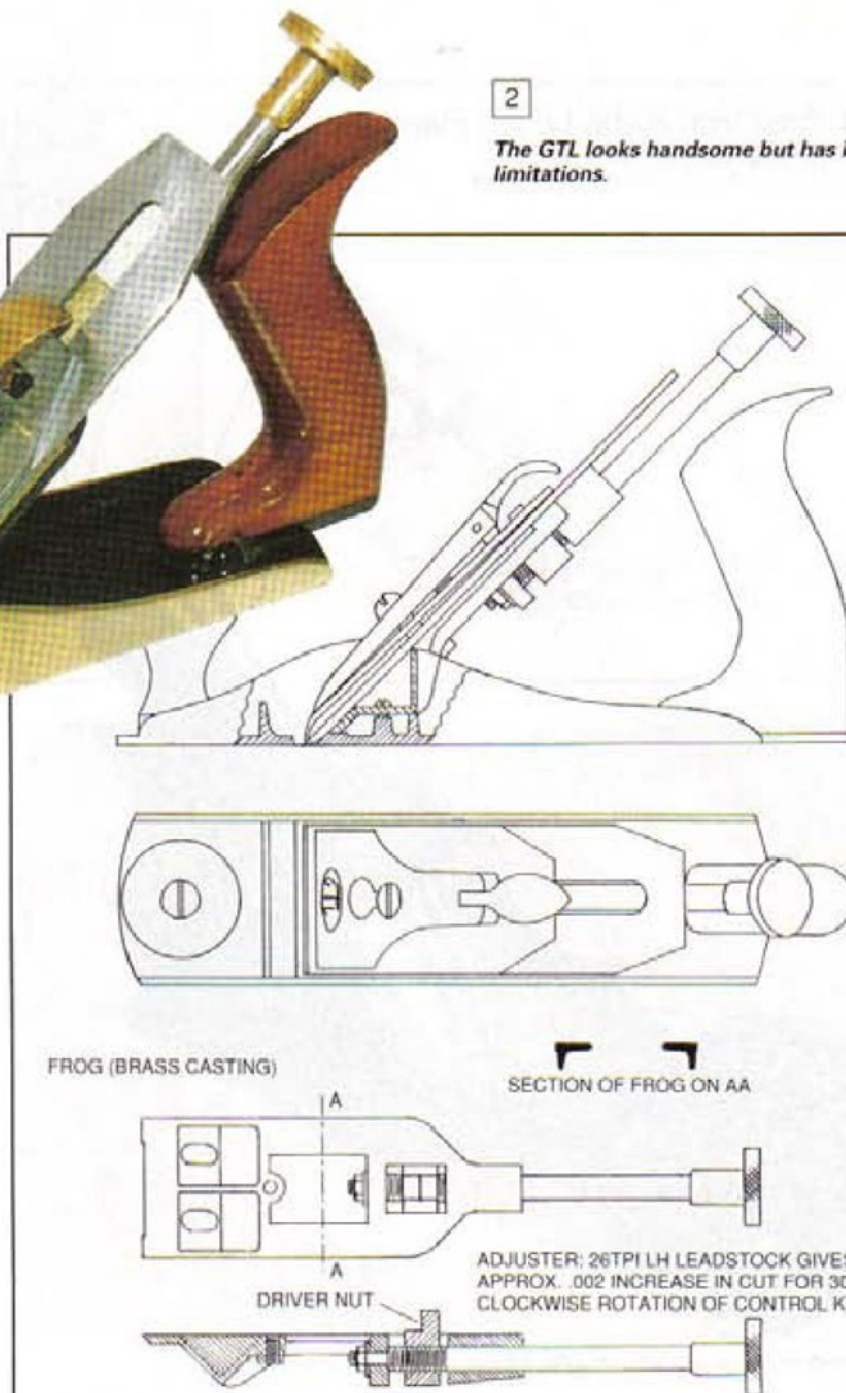
Restoration of the plane was straightforward. The cap was lacquered red after removal of the residual plating and the body cleaned up and re-painted. The existing blade seating gave too wide a throat gap and this was reduced to 2mm by epoxy bonding a 0.032in. shim into place. The 0.055in. blade was replaced by a short length of 0.062in. flatstock left over from a previous job and this was hardened and tempered. On examining the sides of the body I found these had drawn in by a maximum of 1.6mm which probably accounted for the narrow lands on each side of the sole of the plane which did not clean up on flattening. Finally the clamping screw boss had to be re-drilled and tapped square and oversize as the skew already noted would have pushed the blade out of position on tightening.

Experience with the 110 proved to be an excellent starter for more serious later work and yielded a working plane for minimal effort and cost. This could, if desired have been sold and more than repaid my outlay and time.

The flexible frog

The GTL (photo 2, Fig. 3) was bought in an unguarded moment from the local auction rooms in the belief that a pre-war English brass plane would be a quality product with investment potential. Except in so far as the value of scrap brass is likely to fluctuate with the world price of copper I was badly wrong on both counts. In any case I paid over the odds for this plane. It is an illustration of how not to buy a tool of this kind at auction.

On removal of the lever cap, cap iron and blade the frog was found to be badly



© Fig.3 GTL brass bench plane length 235mm blade width 48mm

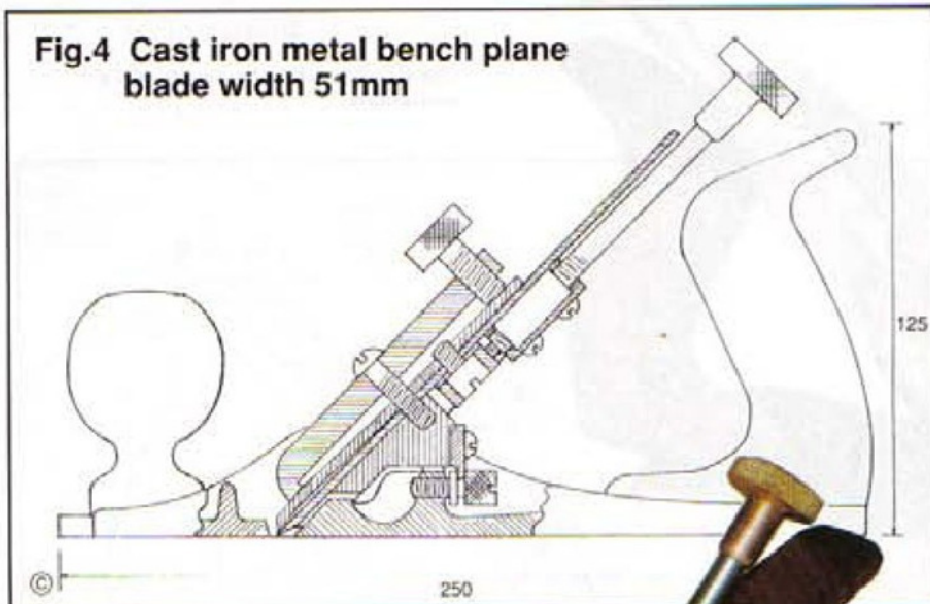
bent. This was held down on as cast surfaces by two $\frac{1}{16}$ in. BSW screws passing through very roughly cast slots. The frog casting itself was scant in that there was insufficient metal to permit setting the blade to a narrow throat width and no adjusting screw had been provided. The reason for its flexibility was an unnecessarily weak centre section which the manufacturer must have been aware of when the planes were completed. The $\frac{1}{16}$ in. x 26 TPI thread in the adjuster nut was stripped, probably as a result of attempting to adjust the blade with too much pressure on the lever cap. The rear handle was held between two cast lugs at its front end and by a $\frac{1}{16}$ in. x No.6 steel screw passing through a rear projection from the plane's sole which had been fettled $\frac{1}{16}$ in. out of position. Added to this the flanks of the body were badly out of square and varied in thickness from 1.5 to 3.0mm. The one quality component was the lever cap, but this had not been fitted with a spring under

its clamping lever.

Restoring the plane to a working condition did not prove difficult, the only operation of note being the chasing of the $\frac{1}{16}$ in. x 26TPI LH internal thread in a new leadscrew nut. The first trial was disappointing and it was put on one side for reflection. On picking it up again some weeks later I found that the frog had gone back into its original bent state. Straightening the brass again appeared to toughen it and the plane was put to work on mahogany. The adjusting mechanism worked well, increments of 0.001in. being easily set on the adjuster working up to a maximum chip thickness of 0.01 inch. The absence of the frog and transverse blade adjusters was unsatisfactory however.

The plane could not, in all honesty, be re-sold as a working tool, despite the work put into it and its attractive appearance. While it would make an interesting mantelpiece job for a brass collector it would certainly not raise the money paid for it.

**Fig.4 Cast iron metal bench plane
blade width 51mm**



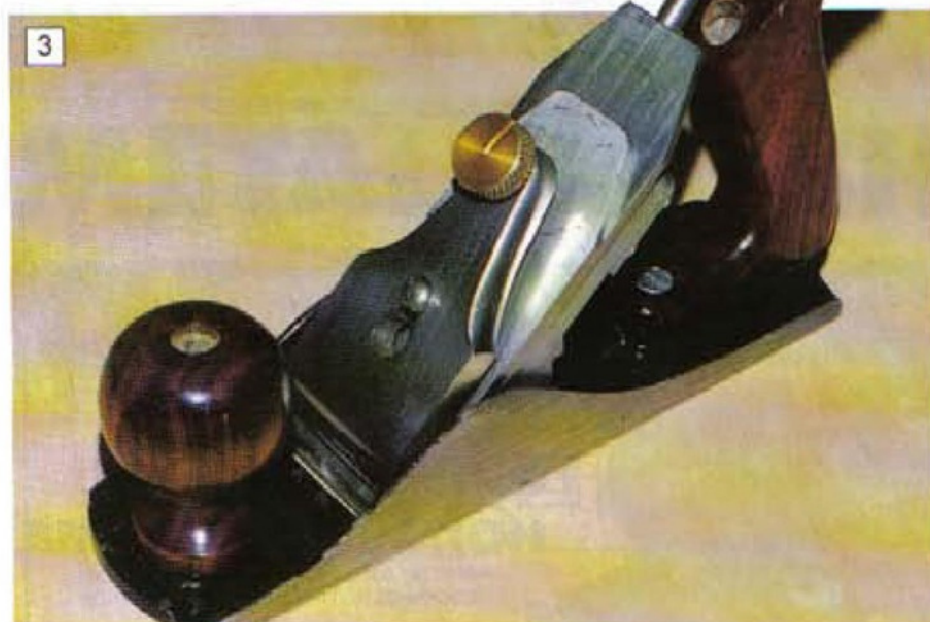
tapped at one end to receive a right hand M5 screw which is fastened to the driving collar. The one weakness of this arrangement is the M5 screw which, although of high tensile steel, would stand little abuse. I found that single radius lines engraved on both the adjusting and clamping knobs were helpful in setting the plane up and for repeat settings.

The plane came up to expectations in every way and subsequently found application as a test bed for checking the performance of different types of blade. There is, however, a considerable difference in the time required for a constructional project of this kind as opposed to reconditioning worn or damaged planes. Making it took up most of a year's evening course in metalwork but proved to be a very worthwhile project from which much useful experience was gained.

Adjustable nose

I had been interested for some time in the possibility of making a fixed bed plane with an adjustable nose but wasn't sure how to set about it until reading an article on the construction of a mitre plane (*Woodworker, Sept. 88 page 806, photocopies are available from Argus - Ed.*). The design offered the possibility of incorporating a thicker front soleplate which could house a sliding nosepiece. Some block planes have this feature, but it

Rear view showing the blade and frog adjusters.



A heavily built smoothing plane on a No 4 base.

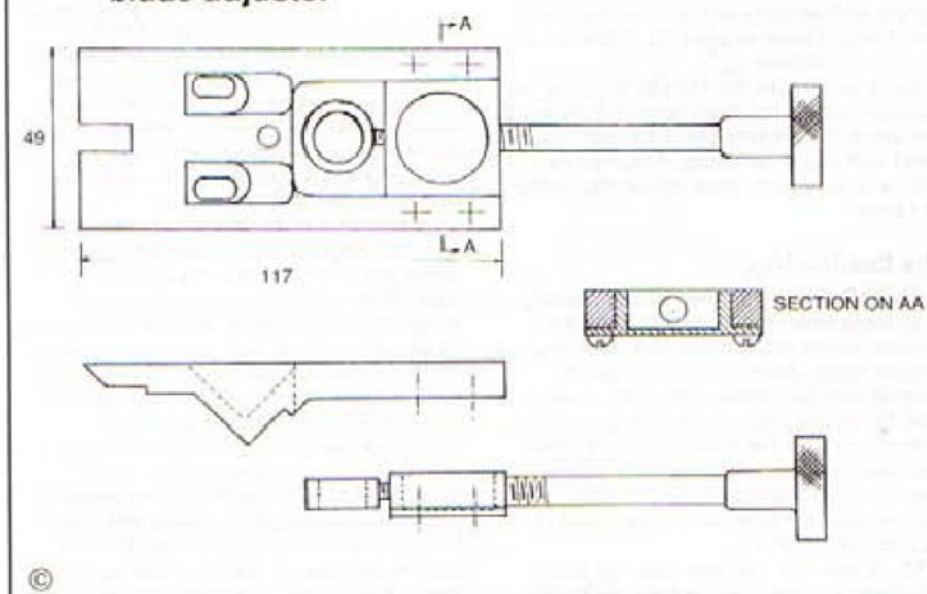


Eastern promise

The idea of building up a plane from a body casting materialised after purchasing, out of curiosity, a replica No.4 (**photo 3, Fig.4**) imported from the Far East. These may be obtained for as little as £4.00 from market stalls, and those currently available at this sort of price are probably the residue of an early lower quality batch. While most of the components are not reusable in a project of this type, the body casting itself is robust and makes an economic base for an experimental plane. The pad faces require attention and the sole will need flattening but it can be assumed that the casting has been well weathered from its sojourn in the town market place. It will also be found preferable to remake the rear handle and front knob.

My general approach to the rebuild was to incorporate a Norris type blade adjuster in a steel frog and to combine this with screw clamping of the cutting blade to permit easy control of pressure for blade adjustment (**photo 4, fig. 5**) The adjuster comprises a right hand M8 screw working through a bronze bush and is drilled and

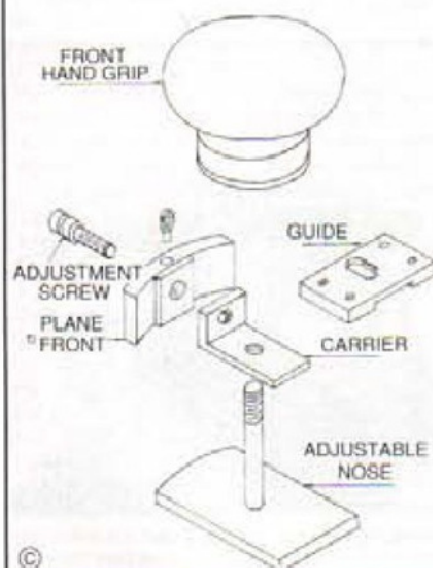
**Fig.5 Frog (mild steel) and
blade adjuster**





The combination of a fixed bed, adjustable nose and fine-thread adjuster makes a useful precision plane.

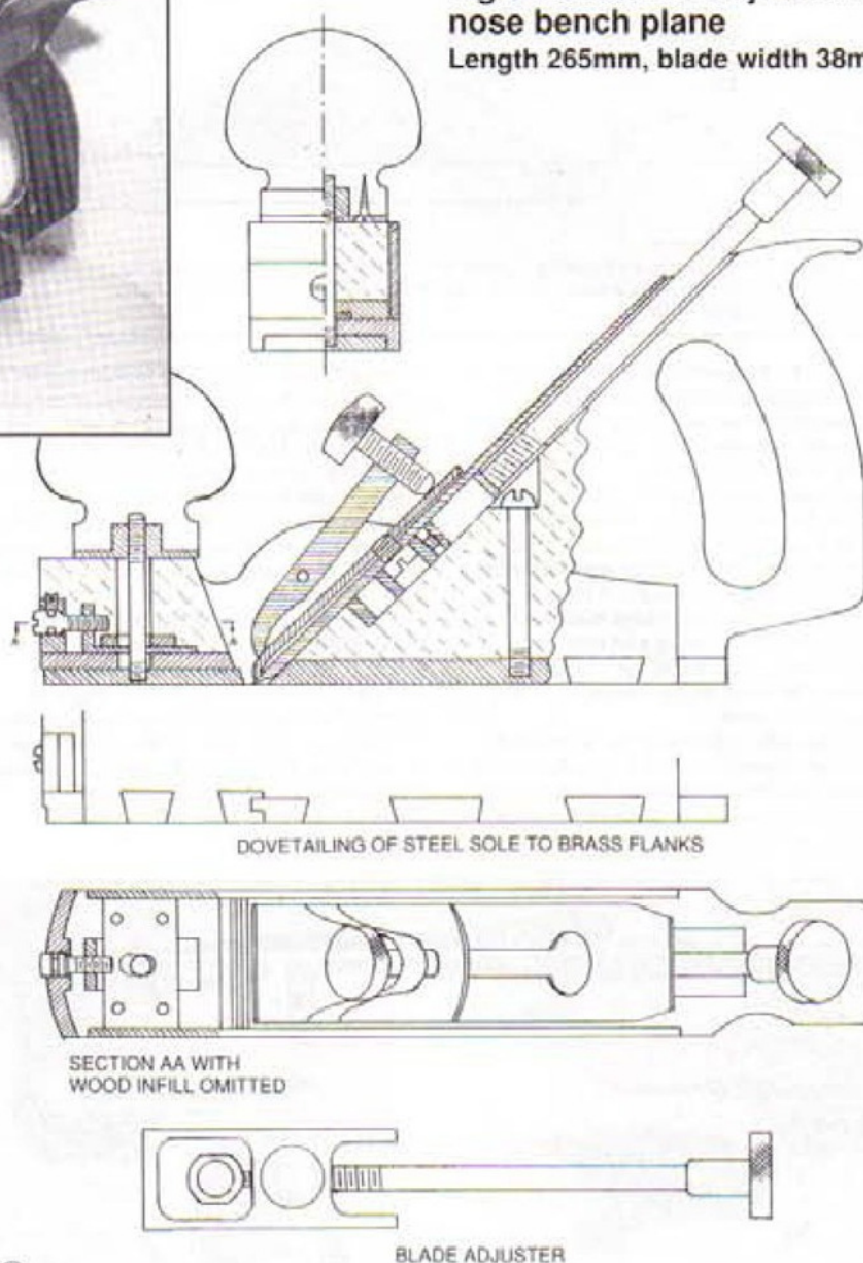
Fig.7 Adjustable nose plane



has not gained general acceptance in bench planes, presumably because selective fitting would be involved, with consequential high cost. The combination of a fixed bed with an adjustable nose gives solidity, with the additional advantage of not having to dismantle the plane to set the mouth width. Nose adjustment is made by slackening off the hand grip and turning the adjustment screw in the front of the plane with a screwdriver (photo 5, Fig. 6 & 7). The thread is preferably left hand, so that clockwise rotation of the screw narrows the gap. The blade adjuster was made with the same M8/M5 thread combination as before but designed as an independent unit dropping into a pocket in the bed without the use of securing screws.

The plane performs exceptionally well with its enclosed rear handle and mushroom-shaped front grip giving a secure and comfortable hold. The narrow base and relatively high holding position takes some getting used to but is a certain cure for any previous tendency to roll a plane.

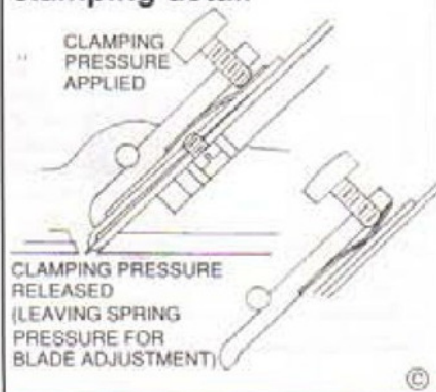
Fig.6 Dovetailed adjustable nose bench plane
Length 265mm, blade width 38mm



Second thoughts

Despite reducing the end of the blade clamping screws on the two planes made so far, to a small diameter spigot there still seemed to be tendency for blade movement to occur on clamping. It was therefore necessary to attach a spring

Fig.8 Modified blade clamping detail



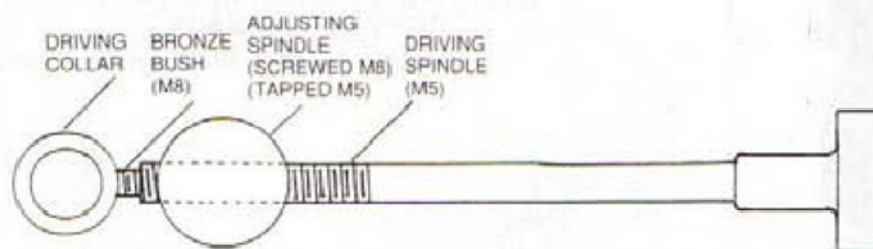
made from 1.25mm flatstock to the cap (Fig.8). In the case of the adjustable nose plane it was found that the original pivoting arrangement of the cap iron blocked visibility of the throat, so this was duly replaced by a stout fulcrum pin and a new design of cap with a pin locating groove. When pressure is released by slackening the clamping screw the spring transfers a lower pressure to the blade and back iron which is just right for adjustment of the cut.

With the benefit of hindsight the adjustable nose plane should have been designed around a 48mm wide blade. The 38mm came from the original body design as a mitre plane and its adoption was the result of tramline thinking on my part.

Old irons

At the start of the project there was no intention of becoming involved in making plane blades - least of all to compare one type with another. My interest in this aspect came about from seeing a prize-winning suggestion in a magazine. This was that a blade at the end of its life could

Fig. 9 Experimental metric thread blade adjuster



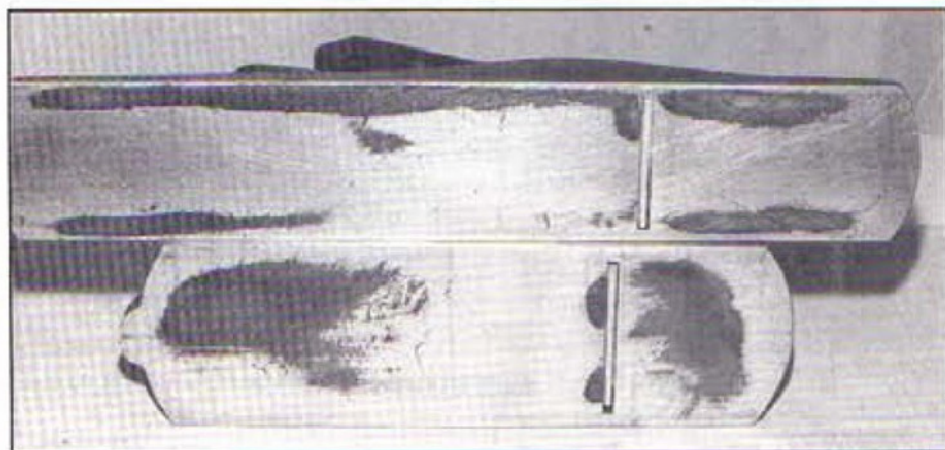
A clockwise turn of spindle advances by 1.25mm but retracts collar by 0.80mm giving net thread pitch of 0.45mm. With a blade set at 45 deg. this increases depth of cut by 0.001in. for a 30 deg. rotation of spindle

be re-used by butt welding a short length of HSS industrial hacksaw blade on to the business end. This had got by the adjudicator, who failed to realise that welding in this way would result in a brittle fracture if any stress were put on the blade. It led me, however, to experiment with welding a piece of flatstock on to a mild steel shank and to follow the welding with a thorough anneal overnight in the domestic fire grate. The blade was then cleaned up and hardened and tempered in the usual way. A perfectly satisfactory blade resulted with a considerable saving in quality tool steel.

The idea was subsequently extended to epoxy bonding an insert of flatstock on to a mild steel shank starting with 1.21mm thick material and later using 0.58mm flatstock. The main problem was to obtain a flat

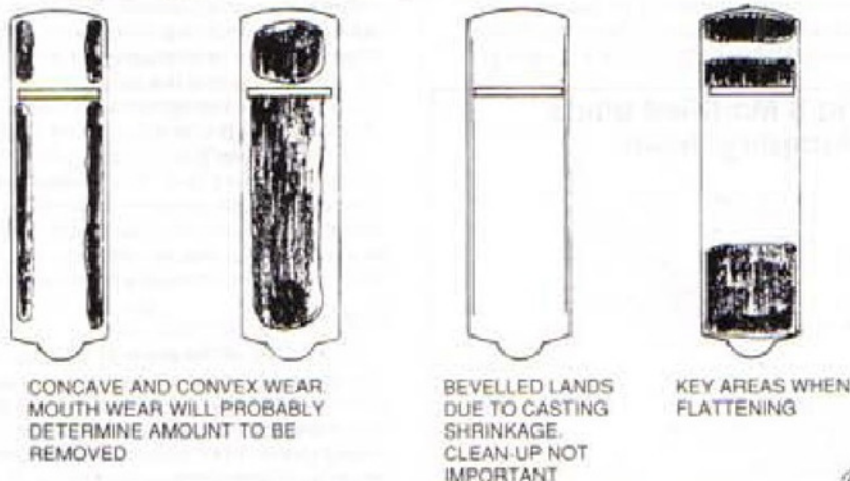
insert after hardening and tempering; in the case of the 0.6mm insert several attempts were necessary before success was achieved. A 25 x 1.25mm HSS hacksaw blade may also be used to make inserts for this purpose, provided it has been hardened through the whole section. This method achieves the same end as welding the HSS without the complication of further heat treatment.

Earlier blades tended to be thicker than today's standard of 2mm and some enthusiasts believe that this gives an advantage in that they are less liable to vibrate. To test this out blades were made in flatstock of 1.57 and 1.21mm thickness both of which gave good results, indicating that blade thickness may not be an important factor if the bedding and clamping is sound.



Surface plate impressions on the soles of a well used No 5 and little-used 4 1/2.

Fig.10 Typical contact patterns



Blades are currently available in plain carbon or chrome vanadium steels, the latter possibly approximating to flatstock, which is the only tool steel readily available in a suitable form to the amateur. A case is often made, however, for the older steels, the arguments being based on their purity and method of manufacture. Different types of obsolete plane blades are still available from specialist stockists for users with this preference; sometimes these show up in car boot sales. I recently obtained two types in this latter way at a cost of 50p each, the solid blade needed a slot cut in it before being pressed into service.

Sole licence

In recent times attention has been drawn to the effect on performance of the flatness of the sole in new and worn planes. It is claimed that some new planes require attention in this respect before being put to work. That there may be a problem is confirmed by the recent experience of a North American retailer offering bench planes with a prestige marque. These were imported to a higher than normal specification, but the company found that nearly all of them required the sole to be re-ground before issue to customers and finally gave up the idea.



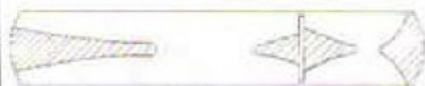
Checking out the sole of a 4 1/2.

The situation rises from the instability of the body casting before, during and after machining. Originally the castings would have been roughed out and weathered prior to finish machining but this procedure has long since been replaced by a stress relieving heat treatment. The flatness tolerance quoted for new prestige planes is ± 0.0015 in. but for standard production planes it will be set higher. Flatness errors in used planes are different in that these may have been worn hollow by extensive jointing or rounded off by tipping and rolling the plane. The passage of shavings through the mouth of the plane will also cause wear which may exceed 0.005in. in the case of well-used planes.

An impression of the state of the sole can be obtained from a surface plate contact pattern (photo 6, Fig. 10) and any remedial action taken followed through in this way. The No.5 jack plane showed evidence of hollow wear with possible tipping and slight rounding. The 4 1/2 appears to show the print of the frog although this was only tenths. To probe further requires a dial indicator plot (photo 7, Fig.11) which can then be reduced to simple contours. In

Fig.11

0.001in. CONTOURS FROM DIAL INDICATOR PLOTS MAXIMUM DEPARTURE FROM FLATNESS IN SHADED AREAS IS 0.003in.



HOLLOW WEAR ON WELL USED NO.5



CONVEX FORM OF LITTLE USED NO.4 ©

both cases (except for extreme corners) the maximum error was 0.003in. which brought the planes into a ± 0.0015 in. tolerance band. The two examples cited show that the arithmetic of tolerancing is by no means the whole story. If, for example, a flatness tolerance were fully taken up by a concavity or convexity in the mouth region of the sole the plane's performance would be noticeably affected.

Sole flattening

Given the need for remedial work on the sole of a plane the first choice would be surface grinding - assuming there is access to a machine (possibly through a college metalworking course). An alternative is to take a fine milling cut across the sole, tapering it off toward the rear if the mouth is being cleaned up as a result of wear.

The method used by woodworkers is to rub the plane backwards and forwards on abrasive paper stretched over a flat surface. Aluminium oxide finishing paper is used, starting with abrasive as coarse as 36 grit. Plate glass is also used as a flat base and a frame with a clamp at each end to hold the abrasive is a useful accessory (**photo 8, Fig. 12**). The operation is carried out with the plane fully assembled but having its cutter backed off from the sole.

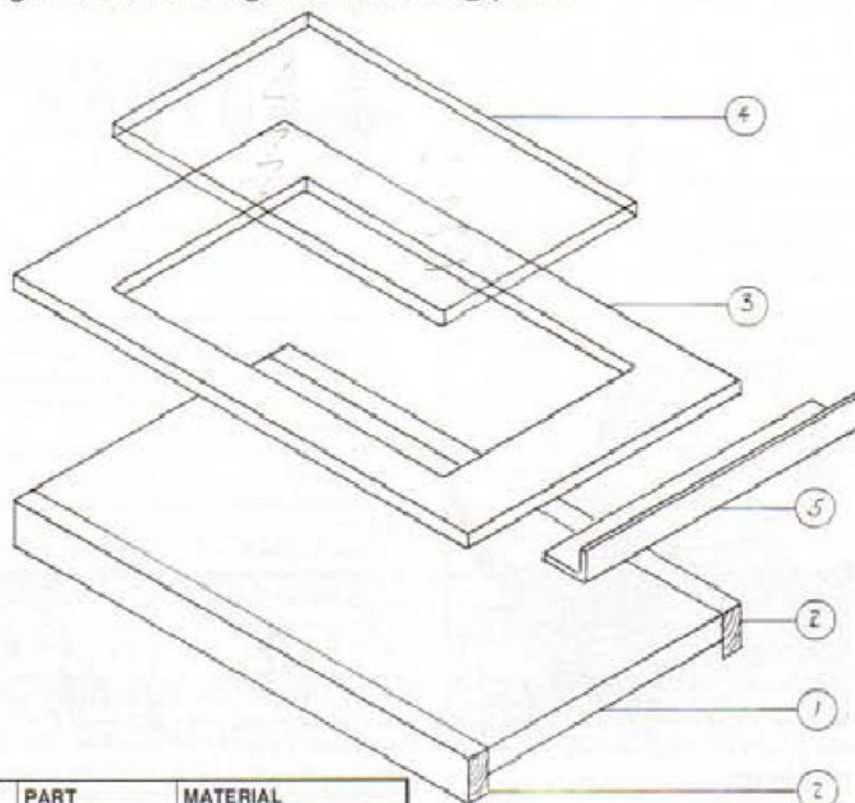
Flatness checks are made with a precision straightedge but reliance is also placed on the coverage of the sole by abrasive contact as indicated by a polished or matt surface. The weakness of the latter is that complete coverage may be indicated if the sole has been made convex and also that abrasive used in this way will give an optimistic indication, as may be checked on a surface plate. The coarser the abrasive the greater the lie! The operation has to be kept in perspective, however, as its objective is to produce a flat surface suitable for planing.

My well used No.4 had mouth wear of about 0.007in. which would have been a very time-consuming job to clean up by the abrasive paper method. A tapering milling cut was taken over the sole, cleaning up the feed marks with 60 grit paper. Two 15 minute sessions were required using up about 2 metres of 115mm wide paper and resulting in a well polished surface. Checking on a surface plate showed that about 40% contact had been achieved. By weighing the dust on a chemical balance I estimated that about 0.0008in. of metal had been removed by the abrasive.

As retailed for small quantity purchase, aluminium oxide finishing paper seems to come in narrow widths of about 100mm and it is therefore necessary to put two lengths side-by-side on the lapping plate. It



Dressing an 800 water stone using silicon abrasive on a glass plate.

Fig.12 Frame for glass flattening plate

PART	MATERIAL
1 BASE (1)	25mm MDF
2 STAND-OFF (2)	50 X 25mm HARDWOOD
3 FRAME (1)	9mm PLY
4 PLATE (1)	10mm GLASS
5 HOLD-DOWN (2)	35 X 20 AL. ANGLE

does not follow that a higher quality paper will give better results as some release of grit is necessary to keep the process going. I also found that silicon carbide abrasive belt material was not effective for this kind of hand work on cast iron.

The bevel

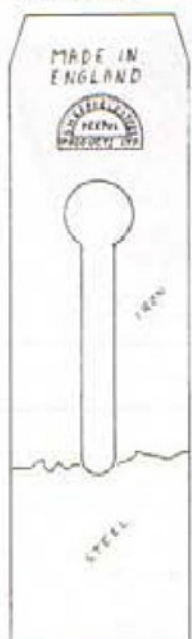
Many years ago, when employed in a large machine shop one of the few perks was the luxury of having precision ground bevels produced on a surface grinder. After moving on, the limitations of attempting this operation on a twin-wheeled tool grinder became all too evident but in those days there was no time to make up a decent fixture or to hunt round for more suitable grinding wheels.

An opportunity to break away from this situation occurred when a small shop-made milling machine was purchased for

conversion into a surface grinding fixture using a Picador speed shaft No. 295 as a grinding spindle. With an adjustable angle table made from castings supplied by The College Engineering Supply Co. and a diamond trimmer fixed to the machine table I was (nearly) back to the situation of many years previously. A 60 grit white aluminium oxide wheel is used for bevel grinding and the table is kept moving as quickly as possible, applying very light cuts. There are, of course, many other applications for a fixture of this type (**photo.9**). The epoxy bonded 0.6mm insert offers an even better solution in that the bevel can be filed as the insert is thin enough to hone. If using a thicker insert, such as the 1.25mm ex-HSS hacksaw blade, it is essential to use a clamp over the insert when off-hand grinding. This is in case it becomes detached due to over-heating or for any other reason.

Fig. 13 Different blade types

SCARF WELDED
LAMINATED



19TH CENTURY TECHNOLOGY. CARBON STEEL WELDED TO WROUGHT IRON SHANK. SLOT ROUGHLY PUNCHED OUT.

UNSLOTTED
UNCUT



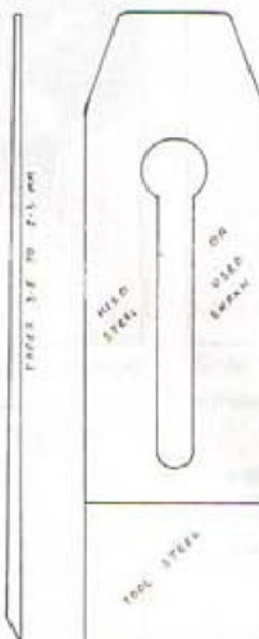
FOR WOODEN PLANES WITHOUT A BACKING IRON IF A SLOT CAN BE CUT BLADE MAY BE USED IN METAL BENCH PLANES.

STANDARD



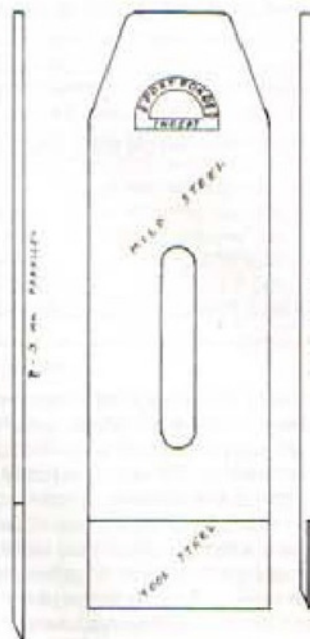
STANDARD U.K. BLADES ARE 2mm THICK AND PARALLEL. SOME OLDER BLADES WERE UP TO 4.5mm THICK.

BUTT WELDED

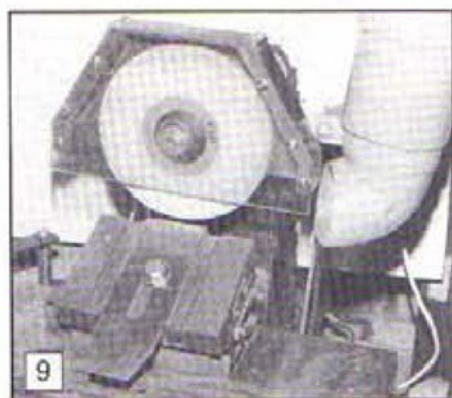


TOOL STEEL BUTT WELDED TO MILD STEEL OR USED SHANK BY MIG WELDING.

EPOXY BONDED



AN 0.6mm HARDENED AND TEMPERED INSERT BONDED TO A MILD STEEL SHANK BEVEL MAY BE FILLED.



Beveling a plane blade on a surface grinding fixture.

19th century technology wins!

Over the period of the plane project more than twenty different blades had been acquired or made and the problem arose as to how to obtain a useful or interesting return for the work involved. All had been prepared for cutting with a carefully honed 30deg. cutting edge and back surface using an 800 water stone for roughing and a 6000 water stone for finishing. In the case of the bonded blades the insert had been left proud of the shank and this, coupled with the flatness achieved, reduced the work involved in lapping the back of the blade. Dressing the water stones proved to be a frequent requirement and 150 grit silicon carbide waterproof abrasive cloth (Carborundum grade CLX 931) was found to be an excellent, if expensive, solution.

Initial tests showed that the blades all cut well on softwood and the softer hardwoods but damage to the cutting edges soon became apparent on harder wood. Formal cutting trials are time-consuming and tend to be subjective in that more time and effort is likely to go into the preparation of the blade you hope will

win - in my case the epoxy bonded thin insert. Eventually, however, a systematic evaluation was decided on for some of the more interesting blades.

The test was to evaluate the damage to cutting edges occurring after a fixed amount of planing first on American rock maple then on gunstock walnut. A 40x stereo microscope was used to examine cutting edges before and after working. At the conclusion of the planing work the blades were sorted by a paired comparison with two edges silhouetted at a time on the microscope stage.

The results, in order of least damage to the cutting edge, were as follows:

1. Peepul
2. 1.21mm flatstock tempered pale straw
3. An alloy steel commercial replacement blade
4. 0.58mm bonded flatstock insert
5. 1.25mm bonded HSS insert
6. Herring
7. High carbon steel commercial replacement blade

The edges on the HSS and the Herring could not be brought up to the standard of the other five blades. The position of the HSS is not surprising as it does not follow that a superior grade of tool steel prepared for quite another purpose will make a good plane blade. The probable reason for the position of the thin bonded insert was the difficulty experienced in heat treating it without distortion. The position of the 1.21mm flatstock blade confirms that a thin blade will work well. The success of the Peepul was a surprise as it is a very roughly made blade. For the future I will carry on using both the Peepul and the thin bonded insert to obtain experience of their performance under different working conditions.

Final note

The renovation and construction of metal bench planes need not be an

expensive activity and is a great user of scrap box material. It is not necessary to get involved in making and heat treating plane irons for which, in any case, a small furnace is a prerequisite. A design based on a welded body is an interesting possibility; provided a friend could be prevailed upon to do the stress relieving as a favour. Walnut is good for infill and handles (a source is old furniture) but beech is a satisfactory alternative. Any wood turning can be undertaken on a metal lathe with sharp, high rake tools. There is much satisfaction to be obtained from using a tool of this kind which incorporates some of your own ideas.

Useful suppliers

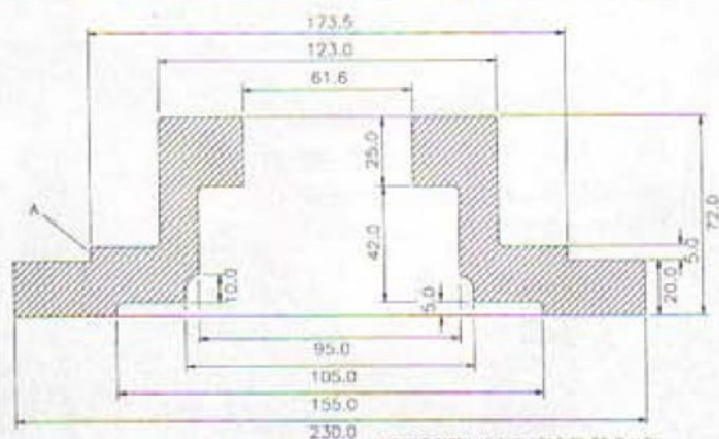
The inclined stereo microscope used for cutting edge examination was a Motic 11A obtained from Beecroft. Seek advice before purchasing a microscope for your own use. Beecroft & Partners, Northfield Road, Rotherham, South Yorkshire, S60 1RR, tel. 0709 377881, fax. 0709 369264.

Pre 1939 cast steel plane irons and high quality plane kits are supplied by Bristol Design, a single issue of the Company's current list is priced at £1.00.

Bristol Design (Tools) Ltd, 14 Perry Road, Bristol, BS1 5BG, tel. 0272 291740.

Carborundum's 300mm wide silicon carbide waterproof abrasive cloth was used for dressing water stones. Ask for nearest stockist. Carborundum Abrasives, G.B., Ltd, Trafford Park Road, Trafford Park, Manchester, M17 1HP, tel. 061 872 2381, fax 061 953 2982.

EAC's 100mm wide Liberty Green Aluminium Oxide paper was obtained by the metre from a local engineering merchant. Ask for nearest stockist. English Abrasives and Chemicals Ltd, Dorey Road, Stafford, ST16 1EA. Tel. 0785 51288, fax. 0785 59428.



FLYWHEEL FOR PDM20 MILL/DRILL

A. SLIGHT TAPER AT THIS POINT TO FIT PULLEY
MATERIAL - CAST ALUMINIUM ALLOY
CHECK ALL DIMENSIONS AGAINST MACHINE BEING MODIFIED.

ADDING A FLYWHEEL TO A MILL/DRILL

Spurred into action by Phil Amos's excellent article, *M.E.W.* Oct./Nov. '93, I decided to make a flywheel as a casting rather than as a steel fabrication. My spindle pulley was removed (some heat was required to free it), measured up and drawings produced for a casting pattern and the final dimensioned item.

At this point the calculator was put into overdrive to establish the weight of the finished item. It came as quite a shock to find that in cast-iron, the intended material, it would scale in at some 26lb or 12kg to

you youngsters. My feelings were that this would present too much of a starting load on the motor. Aluminium alloy was a bit light at 6 1/4lb but when I found that the cost was also half that of the cast-iron, the compromise seemed acceptable.

My local foundry (Wilstead Castings, The Old Foundry, Arlesley, Beds. 0462 835559. Usual disclaimers) soon produced quite a nice casting to my pattern for less than the cost of an evening class session, even at the OAP rates. Incidentally Wilstead's still have the pattern.

P. Wilton lost no time in taking up the idea in the Oct./Nov. '93 issue of *M.E.W.* of adding a flywheel to his mill/drill. However, he produced a pattern, and made it from an aluminium alloy casting. He details his findings in this brief article.

Turning the flywheel took about 4 hours mainly because of the care I took to centralise things, also I'm very much an apprentice to working in metal. A very slight taper was left at point 'A' where I wanted to ensure that the flywheel was truly concentric to the pulley.

When fitting the flywheel to the pulley Loctite Studfast adhesive was used to lock the 4 screws. At the higher speeds momentary belt slip was noticed but no strain on the motor is apparent. A brake has not proved to be necessary.

The harshest test I could find was to fly-cut at 3in. dia. some steel plate using 350 rpm and a 5 thou. cut. The job flowed nicely with no vibration to speak of and resulted in a very good finish.

No photos, the flywheel was similar to Phil's except for colour. I must say thank you Phil for getting me started. I'm now working at a modification to prevent loss of vertical registration during headstock shifts using Jubilee clips to keep the rack in position. I'll let you know if it works.

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NUMBER OF SPEEDS	6

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In this issue we visit Don Hedger in his workshop. Don comes from a non engineering background, and his main interest is in the making of workshop equipment

Don Hedger is typical of many readers of M.E.W., in that he is largely self taught; he has had a little help from a friend, who however is also from a non-engineering background. Don's working life was spent in the printing side of a national daily newspaper, working in Fleet Street, London.

In the later years of his employment, whilst still in the London area, he started to equip a metalworking workshop, purchasing his first lathe in 1971. It was another 7 years before the workshop started to really take shape, when an Amolco milling head was purchased for use on his Myford ML7. Retirement a few years back, and a move away from the London area, gave him the opportunity to establish his workshop in more spacious surroundings.

With more space and time available, it was possible to expand the range of facilities available by the purchase, and manufacture, of other items of workshop equipment.



One corner of the workshop.

We visit DON HEDGER

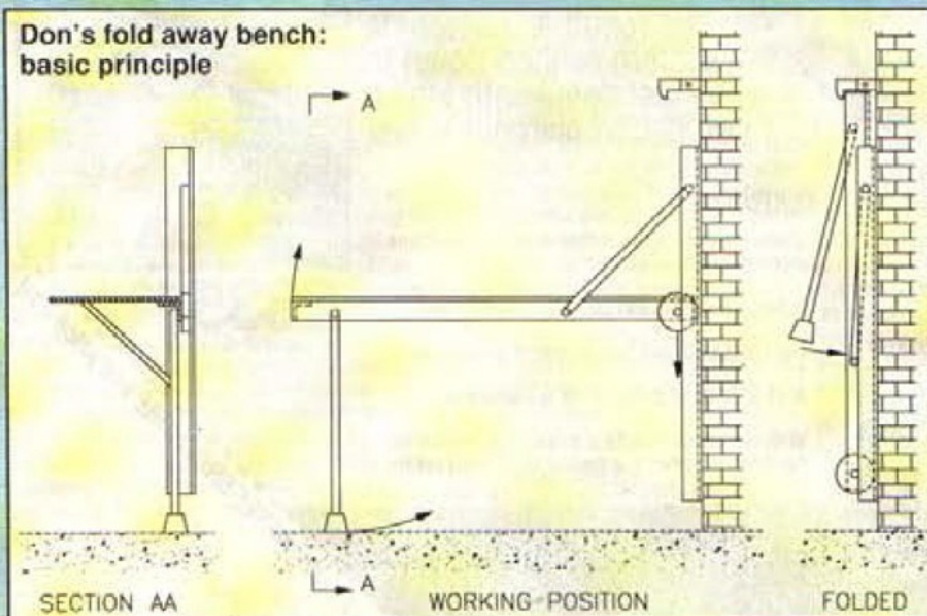


Don's large fold away bench in the garage adjacent to the main workshop.



The ML7 with gear box and Tri-leve speed setting. Note the newspaper cut to shape in the bottom of the drip tray to make keeping it clean an easy operation.

Don's fold away bench: basic principle



A brick built workshop

A brick built extension to the rear of his garage gives a generous 16 x 10ft. area, and having direct access to the garage makes it easy to press this area into service when more room is required. A very large (about 8ft. x 4ft.) and useful foldaway bench, seen in **photograph 1**, has been made with this aim in mind. The front edge of the bench is lifted whilst the edge against the wall runs on the rollers, just visible, down the inside of angle iron guides. Clips are provided on the wall to maintain the bench in the folded away position, in all, making it quick and very easy to use.

The drawing shows the basic principle of the construction if anyone wishes to make a similar item. The workshop is lined and insulated, and heated with a mains gas heater.



Another happy Tri-leve user

The lathe in Don's workshop is a Myford ML7 complete with gearbox and Tri-leve speed selection, **photograph 2**. Don states that he would like to move up to a Super Seven but is reluctant to lose the Tri-leve facility which he finds very advantageous. An interesting idea which he employs for keeping his lathe clean, is to cut from newspaper, about three thicknesses, pieces that fit closely into the lathe tray. This is arranged to fit around the feet of the lathe collecting the majority of the swarf produced, this can then be lifted clear on completion of the project. This leaves only a minimum of cleaning to be done in the drip tray.

Having used the Amolco head with the lathe for many years, Don found this far from satisfactory, both in respect of having to add and remove the unit each time it was required, also the limited table size. As a result, a Dore-Westbury compound table was purchased 2 years ago and married up to the Amolco to provide a full Mill/Drill facility, this can be seen in **photograph 3**. One problem Don found with the Amolco was the limited range of speeds, in particular the lack of a really low speed. To overcome this, an intermediate pulley has been fitted to give a minimum speed of 53 RPM, see **photograph 4**. The large pulley to accomplish this has been salvaged from a tumble dryer. Having proved the arrangement some guards have still to be made.

The workshop also contains one of the popular universal band saws, this he considers to be the second most important item he has, the lathe being first. He points out that, as has been said before in the pages of *M.E.W.*, not only does it make light work of operations which would previously have been done using a hacksaw; but more importantly, makes practical operations which without the aid of the machine would have been considered non starters.

Don found that it was not very satisfactory to move the complete saw around using only the single pair of wheels supplied. To overcome this difficulty he has added a second pair of wheels to the outer (non motor) end of the machine. This arrangement allows the machine to stand on the legs whilst in use; but both existing



3: A hybrid drill/mill, comprising, an Amolco head with a Dore-Westbury compound table.

4: An intermediate pulley, taken from a tumble dryer, has been added to give a low speed of 53RPM.

5: Don's modified wheel arrangement on his universal band saw. This is the subject of a future article.

6: The Ajax drilling machine.

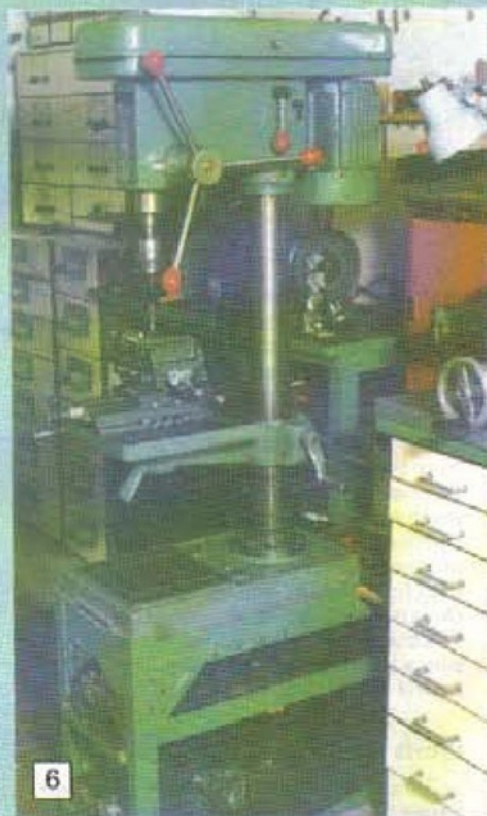
and new wheels have been arranged so that they can be raised and lowered. **Photograph 5** shows the lever, painted white, which is used for this. Details of this modification will be the subject of an article in a future issue.

The remaining major item of machinery is the Ajax drilling machine, **photograph 6**. This has been mounted on a low stand which is used to store his bar stock. The extra weight in the base helps to improve stability. I was confused by this machine as it is too short for use floor mounted and I would have thought too tall for use on a normal height bench. I did consider that it was a floor standing drill that had been modified, but Don confirms that it is as supplied by Ajax.

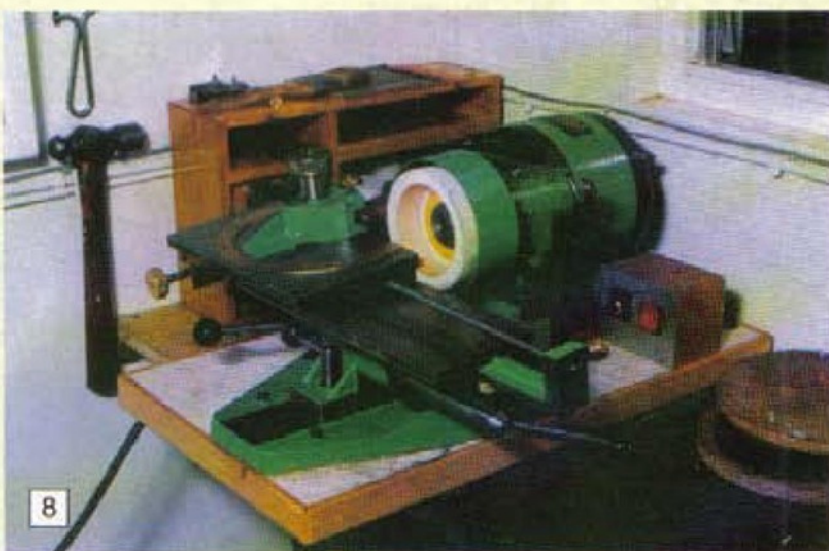
Making workshop equipment

Don's workshop activities consist, like many readers of *M.E.W.*, almost entirely of making workshop equipment. However, like most home workshops, it is pressed into use for general repairs and DIY related activities. These include, in Don's case, the fitting out of his touring caravan.

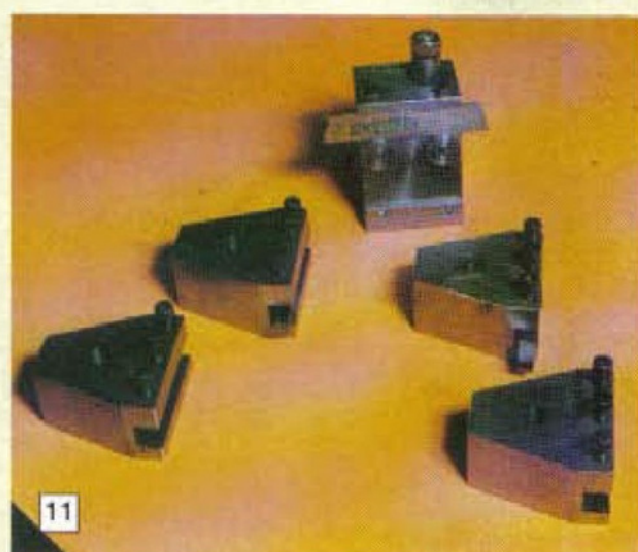
Amongst the workshop equipment made there are some quite major items, and also some less involved, some of his work, I am pleased to see, are designs taken from *M.E.W.* Probably his major item



- 7: A vertical belt sander made by Don.
 8: The Kennet tool and cutter grinder made from a kit.
 9: A Dore boring head made by Don.



- 10: Three items from past issues of M.E.W. - Micrometer holder, issue 4: Lathe tool height gauge, issue 5: Taper turning attachment, issue 9.
 11: A parting tool holder, design taken from a book by Len Mason, and some lathe tool holders which simply sit over the top slide stud. Each has a tool permanently fitted which is immediately available for use.



is the belt sander as this is to his own design, and can be seen in **photograph 7**. He does admit to having taken some aspects of it from some one else's design, well don't we all?

Don has also made the Kennet Tool and Cutter Grinder, **photograph 8**, making this from the kit obtainable from Model Engineering Services. Having completed the machine, he considers it to be a very satisfactory product, very easy to use and producing a very good end result. Another item from Model Engineering Services is the Dore boring head, seen in **photograph 9**. The star wheel on the end of the adjustment screw permits the use of an attachment to permit facing to be carried out.

Items made to M.E.W. designs

Three items made to designs from past issues of *Model Engineers' Workshop* are

illustrated in **photograph 10**. Don finds that the taper turning attachment works well except that the first few millimetres turned is parallel before the taper starts to be formed correctly. I feel that the unit is flexing until the resulting force is sufficient to start the cross slide moving. Don's use of a narrow, rather than full length, angle between lathe mounting bar and the main portion of the attachment I feel does not help. Do any readers have any experience, good or bad, with this design? If so I would like to hear from you.

Photograph 11 shows a parting off blade holder and some lathe tool holders. Whilst these tool holders are not so quick to change as the more usual quick change holders, the difference in time is quite small. Providing the holders are kept with their lathe tool fitted it is just a case of removing the nut on the top of the top slide stud, changing holder and replacing nut

and tightening. Only a few seconds job, and definitely much easier to make than the more recognizable quick change holders.

A welcome chat

Like many readers, particularly those interested in workshop equipment, his workshop time is very much a lone activity. So on leaving, Don said he had enjoyed being able to spend time in his workshop talking to someone of similar interests, and having the photographs taken. We for our part thank him for giving us the opportunity.

Suppliers

For details of the Kennet Tool and Cutter Grinder, and Dore boring head, contact Model Engineering Services, Pipworth Farm, Pipworth Lane, Eckington, Sheffield, S31 9EY. Tel 0246 433218.



HOBGING A CONCAVE KNURLING WHEEL



The completed knurling wheel and a brass handwheel produced from it, seen here mounted on a bolt.

For those into clock making and repair, this article, by Ian Dermott, on making concave knurling wheels will be of particular interest. Even so, I feel sure, others will find applications for this idea. For the remainder, it makes interesting reading

The process I describe here is not a new one, but is, none the less useful; I found it to be the answer for the project that I had in hand.

I was helping a friend to restore and make missing parts for an old french clock, which had a straight knurl around some radiused edges (bezel etc.). I did not possess a suitable knurling wheel so I decided to make one using a tap as a hobbing cutter. The size of the radii required will obviously decide the size of tap that used. In my case a 6BA taper tap fitted the bill. Just a word on that, the tap should be sharp and be of the HSS variety.

Knurling wheels - Figure 1

The knurling wheels are made from stock $\frac{1}{2}$ in. diameter silver steel, drilled and reamed $\frac{1}{32}$ in. Two are hobbed at the same time in an attempt to balance the workload on the tap. The groove is formed using a radiused parting tool, but it is dimensionally critical, to achieve the full form of the tap threads for whatever size of tap is being used. After hobbing harden and temper to a dark straw.

Hobbing Holder - Figure 2

Can be made from almost any scrap of rectangular material to hold in the lathe tool post, to enable the two wheels to be held at lathe centre height.

Knurling wheel holder - Figure 3

Mark out and drill cross hole through with a No. 43 drill, followed by a No.42 to give a push fit for $\frac{1}{2}$ in. dia. silver steel. Drill the $\frac{1}{2}$ in. dia. hole at the rear of the slot, then mount the holder in the lathe tool post. Place a mandrel, fitted with a suitable slitting saw, in the chuck and cut down each side of the slot into the $\frac{1}{2}$ in. dia. hole.

Female Centre - Figure 4

This has proved to be a useful item for other jobs, as well as this one. It is made from silver steel. The centre cone was made by first centring in the normal way with a BSI centre drill; following this with a centre

drill which had the pilot ground to form a continuous 60 deg. cone with a sharp point. I continued drilling with this until the last vestige of the pilot hole just disappeared. The outside taper was turned to give improved access to any items supported by the centre. The cone end was hardened and tempered to a light straw colour.

Hobbing set-up - Figure 5

Assemble the two embryo knurling wheels in the hobbing holder. The edges of the wheels should just touch together but rotate freely. Place this assembly in the tool post, with the centre of the formed radius in the wheels on the lathe centre height. Wind in the cross slide, until the centre line between the wheels is on the lathe axis. Place the taper tap in the chuck or collet and the female centre in the tailstock chuck.

Advance the carriage to the left so that the tap enters between the wheels, you should now be able to engage the tailstock centre. Lock the carriage. Apply oil to wheels and centre. Turn lathe carefully by hand to start with. Provided the tap you are using is well tapered, down to thread core size or below, and everything is correctly aligned, the tap should rotate freely or just start to cut. Run the lathe in back gear. Advance the top slide slowly, apply plenty of oil to help wash away swarf and assist cutting. When the knurling wheels are level with the full thread portion of the tap, the deed is done!

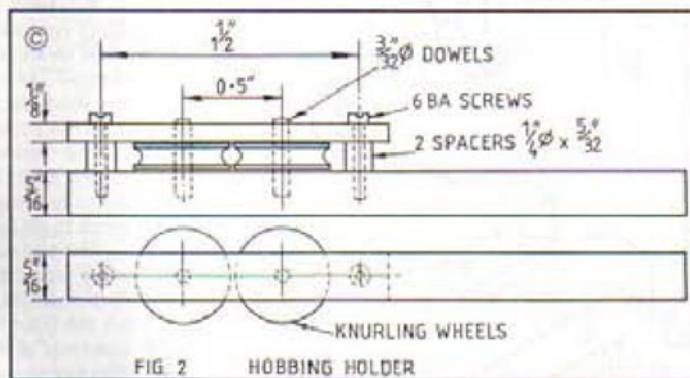


FIG. 2 HOBGING HOLDER

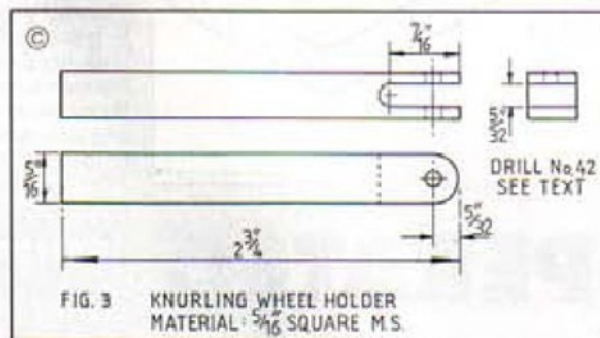


FIG. 3 KNURLING WHEEL HOLDER
MATERIAL: $\frac{5}{16}$ SQUARE M.S.

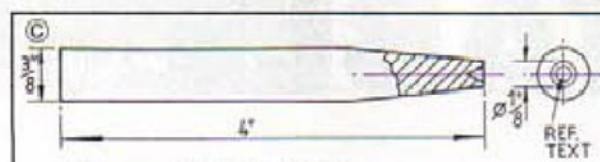


FIG. 4 FEMALE CENTRE
MATERIAL: $\frac{3}{8}$ SILVER STEEL

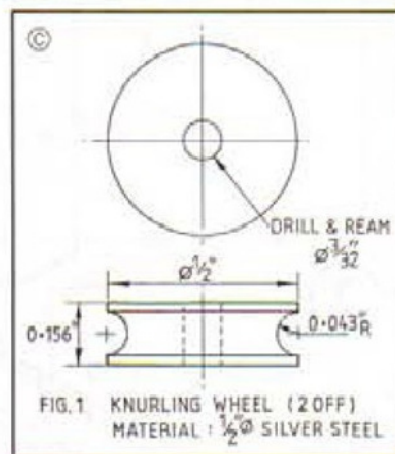


FIG. 1 KNURLING WHEEL (2 OFF)
MATERIAL: $\frac{1}{2}$ SILVER STEEL

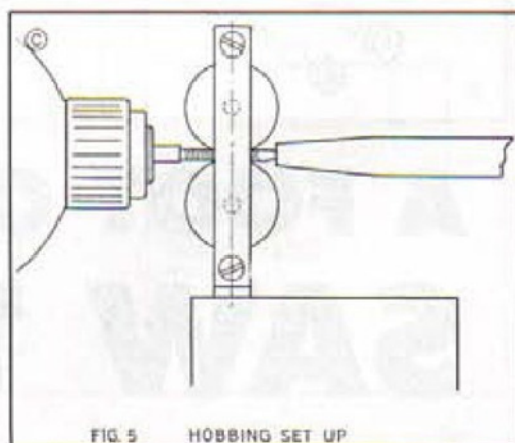
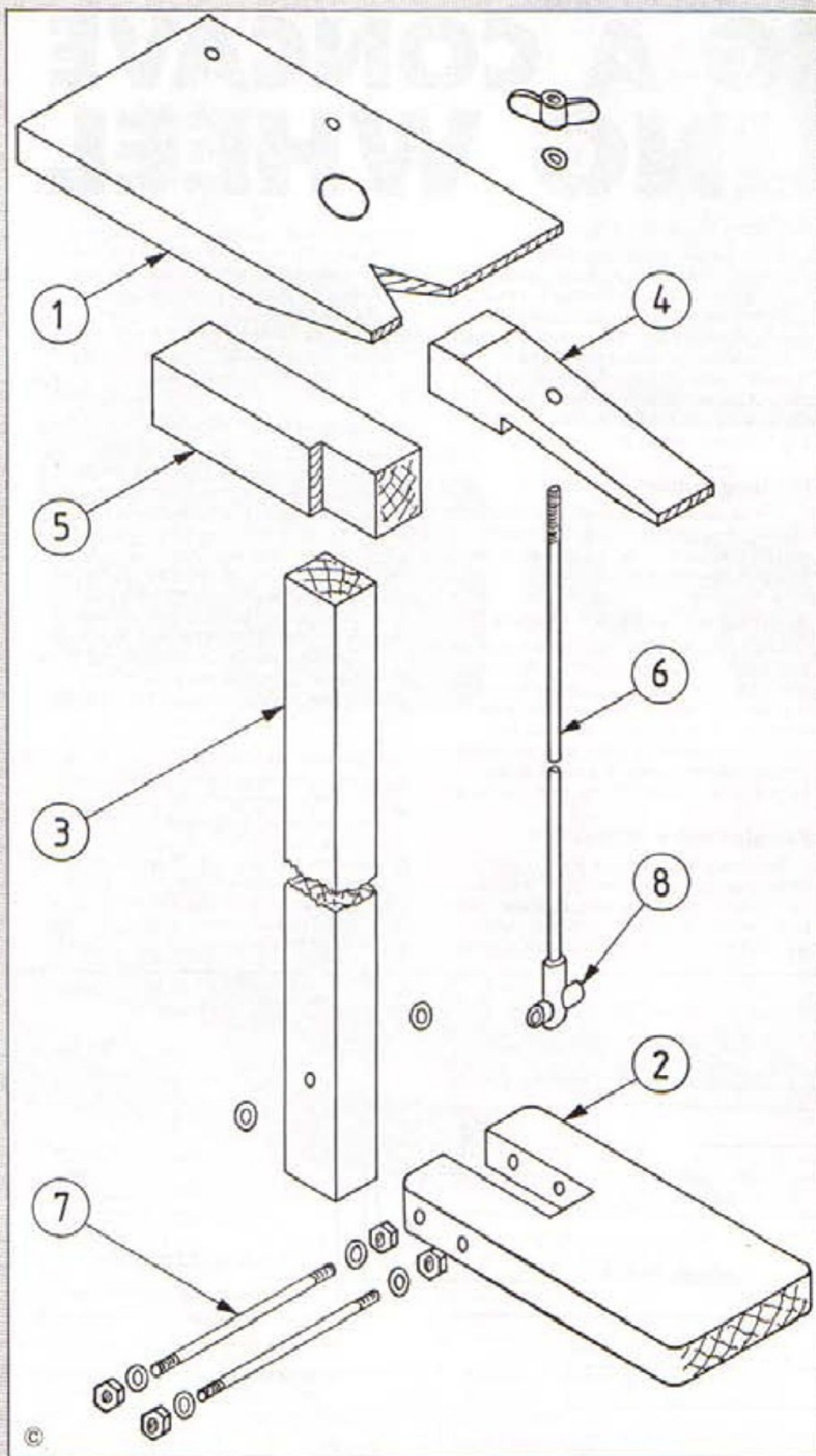


FIG. 5 HOBGING SET UP



Holding a workpiece with one hand, whilst cutting intricate patterns using a piercing saw in the other, can be a demanding operation. The foot operated saw table in this article, provided by Leslie Broomfield, will go some way to easing the task

One of the worst features when using a piercing saw to cut intricate shapes in sheet metal is the problems associated with holding the workpiece securely onto the cutting table. The fingers of the non-cutting hand (in my case the left), always seem to suffer from cramp and their muscles seem to lose strength with remarkable rapidity. Whilst watching my favourite sporting programme on TV I was reminded that the effort of the arms in the Boat Race is no longer paramount, the major effort having long ago been transferred to the muscles of the legs. I felt that a somewhat similar move might be made when using the piercing saw. As the idea began to take shape my mind's data banks dredged forth memories of Saddlers' Clams and Glovemakers' Donkeys. The idea gradually took form and I spent some considerable time contemplating the practicalities of a foot operated table clamp for use when piercing.

A spare piece of 2 x 2 in. timber, some redundant floorboard and a length of sash bar eventually surfaced and the job got underway; it is now a useful addition to the workshop.

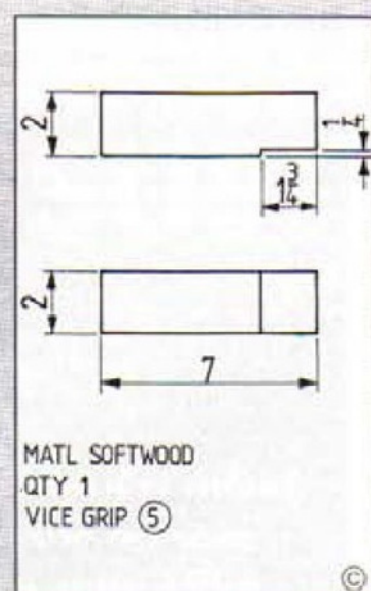
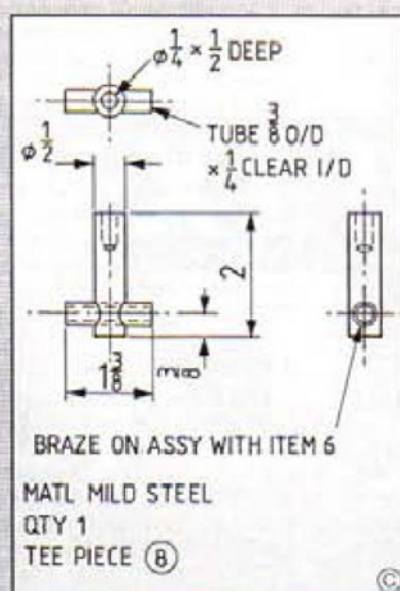
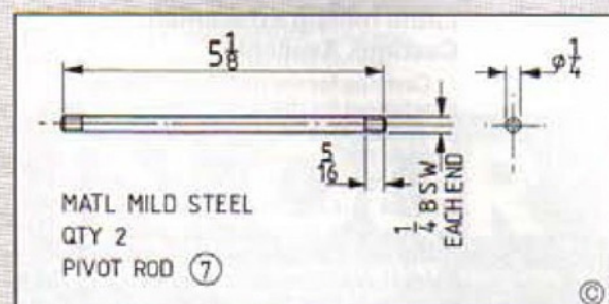
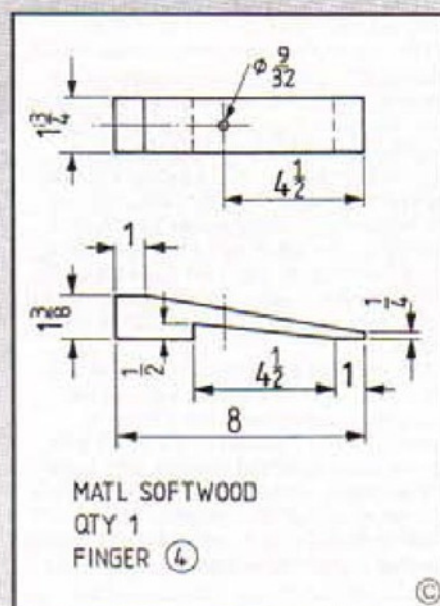
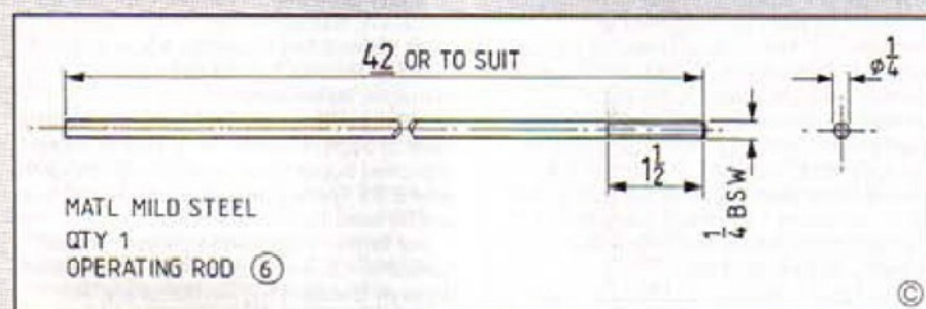
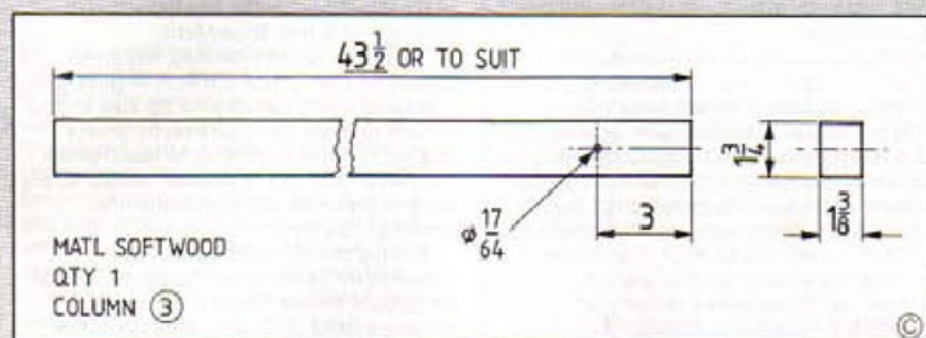
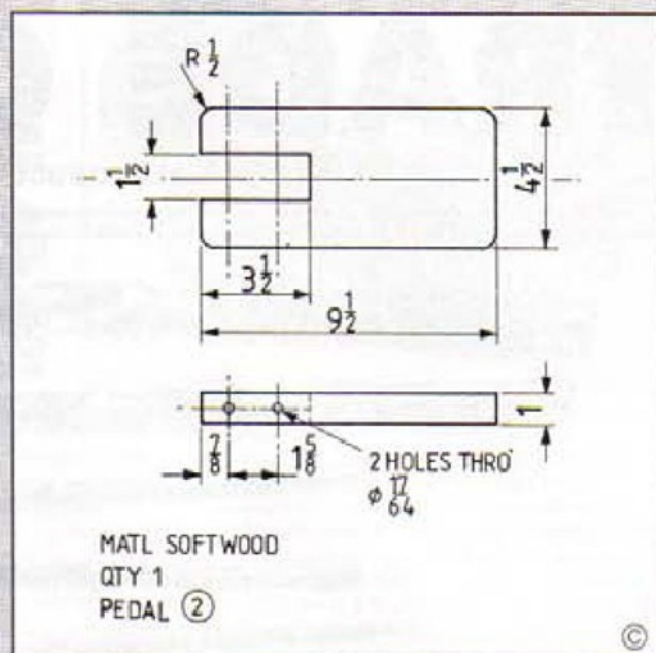
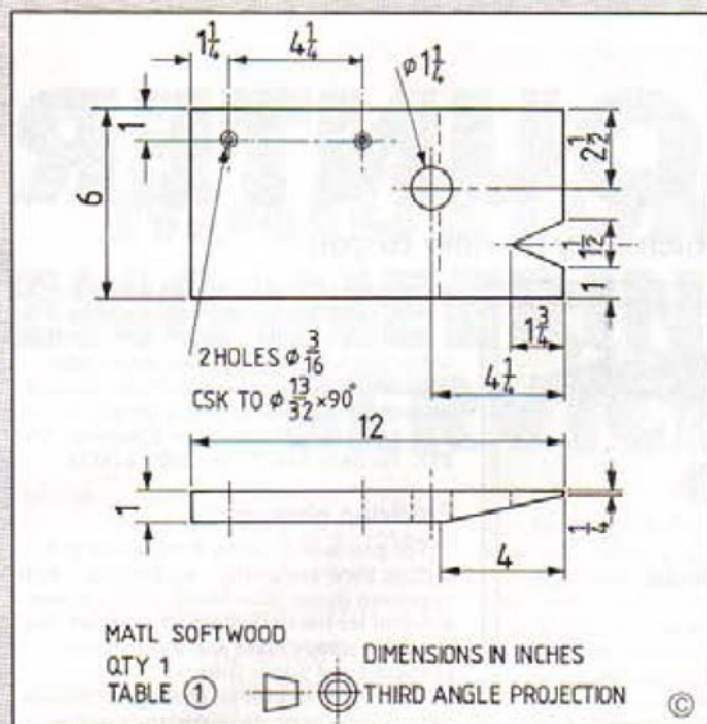
You have probably already asked "Why don't we just hold the workpiece to the table by the use of a toolmakers or G clamp? The answer is simple, very often the workpiece has to have several moves; with my system, lift the foot and the work can be moved instantly, without even letting go of the saw handle. Lower the foot again and the job is securely clamped. Do I need to go further?

The size of the table is purely arbitrary, mine was dictated by the material available, the height of the column by the off the floor height of the bench vice, and the 1 1/2 in. dia. hole is the largest centrebit that I possess. No constructional details are given, the drawings should make all clear. The only glued joint is that between the vice grip and the column, P.V.A. glue (Evostick Resin W type) was used and in my case seems to be adequate. I have had no problems up to the present. Foot pedal and table are from 1 in. nominal thickness timber, and the column is a length of 2 x 1 1/2 in. sash bar. The 1/2 in. dia. steel rod came from some black mild steel left over from a previous job, as were the nuts and washers. The tee piece was a short length of 1/2 in. OD 0.035 in. wall thickness steel tube brazed into a 2 x 1/2 in. steel rod found in the scrap box. (The main attraction of this latter item was the fact that it had a convenient cross hole already drilled in it!).

Despite its apparent crudity the tool works very well, I wish that I had thought of it years ago.



A FOOT OPERATED SAW TABLE



Diestock alternative

Do you have a few dies which don't fit any diestock you have? These are often large ones that are only used to clean up an existing or screw cut thread, in which case clamp a Jubilee clip round them and adjust to suit. This will take a surprising amount of torque and saves time making a holder.

Hugh Mothersole

TRADE COUNTER

A first look at products which may be new to you



Tin coated drills

This brief review regarding Tin coated drills has been provided by Stan Bray.

The use of Titanium coated drills, milling cutters, etc. has long been recognised in industry. The distinctive gold colour will be seen wherever high volume production is involved. Generally speaking the use of such tools has been a bit beyond the model engineer owing to the high cost involved. The wholesalers, Messrs Sealey are now importing a range of two sets, one metric the other Imperial. Each set consists of 21 drills in a plastic case. The drills are normal high speed type with the addition of the coating.

The Imperial set is from $\frac{1}{16}$ in. to $\frac{1}{2}$ in. in steps of $\frac{1}{16}$ inch. The metric set is in half millimetre increments from 1.5mm to 10mm with the addition of 3.2 — 4.2 and 5.2 mm diameters. For readers who have no knowledge of the properties of titanium then the explanation is simple. The material allows swarf, etc. to escape rapidly from the work. The result is that the tools

can be used at higher speed and have a longer life, no coolant is needed. This property is particularly valuable when drilling "sticky" materials such as copper. As a result of this quick metal removal there is less wear on the tools and so less sharpening is needed. In industry they simply throw them away, but the coating on the helix still works after re-grinding. It has also been noted that where self powered drills are in use recharging periods are lengthened because less pressure is needed to carry out the work.

The tools are sold by many of the six thousand retailers stocking Sealey products. The boxes are marked at a retail price of £53.95 excluding VAT, but in fact they are invariably being sold at a considerably lower price than that. Graham Engineering (Midlands) for example retail them at £40.00 plus VAT and in fact sold them at the Model Engineer Exhibition for £28.95 including VAT. It will therefore pay to shop around when no doubt a real bargain can be picked up.

actual speed range achieved will also depend on the motor and machine being driven.

For details of the units, manufactured by Mitsubishi, and their suitability for your application, contact Newton Tesla (electric drives) Ltd., Unit G18, Warrington Business Park, Long Lane, Warrington, Cheshire, WA2 8TX. Tel 0925 444773 Fax 0925 444773.

Precision glueing

For precision glueing at the touch of a button, think automatic... systematic... think improved Super Glue Matic, Loctite's new solution for dextrous domestic repairs that require a steady hand and the accurate application of Super Glue.

To provide improved glueing control on difficult jobs, such as repairing costume jewellery or handbags, as well as craft work and modelling, Loctite has launched redesigned Super Glue Matic.

This easy to use non-clog dispenser allows you to control the flow of glue as a tiny bead and an extra long tip also allows people to place the glue exactly where required — even in difficult to reach areas. For extra security the double closure safety feature prevents accidental opening, especially by children.

Simple to use, Super Glue Matic operates by gently pressing the two tongs on opposite sides of the dispenser to release a bead of glue. Letting go of the tongs immediately stops the flow.

Super Glue Matic is suitable for use on porcelain, leather, metals, wood, card and most plastics and is available at only £2.59.

Steve Morran, Loctite's Marketing Manager, comments:

"Many delicate gluing jobs require just a trace of Super Glue for an 'invisible' mend. Improved Super Glue Matic puts glue exactly where it's needed providing controlled flow and no waste for a trail-free bond."

For further information please contact: Consumer Division, Loctite UK, Watchmead, Welwyn Garden City, Hertfordshire, AL7 1JB. Tel: 0707 331277.

New catalogues

Frost Auto Restoration Techniques Ltd, have brought out a new catalogue. This contains tools and equipment, many of which would be difficult to locate anywhere else. While mostly applicable to car restoration, there are many items of interest to the home workshop owner, including those whose interest is in model engineering.

For a copy of the catalogue, contact Frost Auto Restoration Techniques Ltd, Crawford Street, Rochdale, Lancashire. OL16 5NU. Tel 0706 58619 Fax 0706 860338 (Mention M.E.W.).

Screwfix Direct, the supplier of a wide range of threaded and other forms of fixings by mail order, have brought out their latest catalogue, No.33. In addition to threaded components there are such items as hinges, brackets etc and a few tools.

Metric threaded fastenings are available in quantities of 10, 25 and 100 which is ideal for the user of small quantities.

For a copy of the catalogue, contact Screwfix Direct, 15 Oxford Road, Pen Mill Trading Estate, Yeovil, Somerset, BA21 5HR. Tel 0935 414141 Fax 0935 32375.

Change of address

John K Flack, supplier of materials and tools, particularly in the very small sizes, has changed address. The new address is John K Flack, 1 Meadowbank, Kilmington, Axminster, Devon EX13 7RL. Tel 0297 32398.

3 Phase Inverters

One company actively entering the market for the supply of 3 Phase inverters to the home workshop user is Newton Tesla (electric drives) Ltd. Their selection of units covers a wide range of power outputs. The one most likely to be of use in the home workshop is their U120, having a power output range of 0.1 to 1.5kw and an output frequency range of 0.5 Hz to 120 Hz. The

Lathe milling attachment — Castings Available

Castings for the horizontal milling attachment for the lathe, featured in issue 21 of M.E.W., are now available from College Engineering Supply. The price for a pair of castings, including post, packing and V.A.T. is £28.85. Orders can be placed by telephone using a credit card.

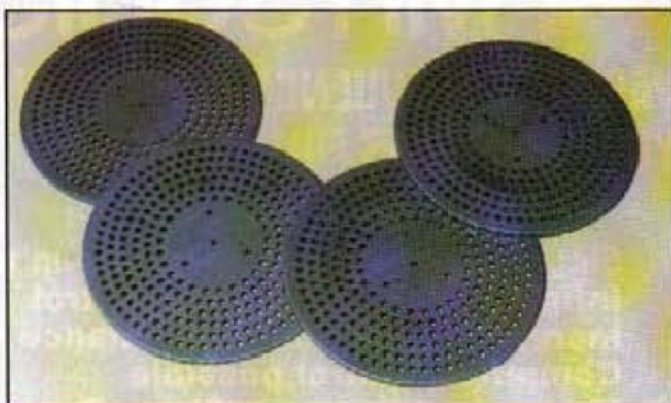
Contact College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton, WV8 1EJ. Tel. or Fax. 0902 842284.

Layout fluid alternative

Instead of using blue layout fluid when marking out holes etc. on small jobs, the metal surface can be coloured with felt tip pen and, when dry, scribed lines can easily be seen.

Alan Jeeves

We visit - MAIDSTONE ENGINEERING SERVICES



Maidstone Engineering Services (Sales) are a well known supplier of materials to the model engineering fraternity, their operation is also of considerable interest to the non modelling readers of this magazine

Maidstone Engineering Services (Sales) started like many other companies; an existing company saw the need, for what ever reason, to branch out into a new activity. In this case the company in question was involved in industrial instrumentation, and due to a slight recession at the time, found itself with a slightly reduced order book. Even more important, was the fact that this resulted in a small property, complete with shop front, laying idle. As a result, Maidstone Engineering Services (Sales) was born some ten years ago. This was, and still is, aimed very much in the direction of the model engineer. They do have a wide range of engineering materials which will be of interest to non model making readers of *M.E.W.* In fact, some business is done locally supplying small engineering firms.

The company remained in the hands of the original owner until, about five years ago, it was sold to the present owners. Even so, the original owner still shows a considerable interest in the business, frequently turning up for a chat with both owners and customers alike, as he did whilst I was there. Terry Gausden, the present owner, now runs the business, very ably assisted by his wife Sylvia.

Range stocked

The product range can be said to be divided between, specific materials for locomotives typically castings, raw materials and fastenings in general, small tools and just a few other items, such as books. The split in terms of catalogue pages is very approximately 40%, 50% 8% and 2%, what it is in terms of turnover I did not ask.

At the present the split between mail order and counter sales is about 50:50, but Terry states that the mail order side is very much an expanding area. To assist in this direction a catalogue is issued twice a year. Export orders are taken, which presently amounts to some 10% of turnover, and payment by major credit card is accepted. Orders received by mid-afternoon are invariably dispatched the same day. An attempt will be made to dispatch urgent orders the same day, even if received later.

Material specifications quoted

It is encouraging to note that materials listed are, almost without exception, detailed precisely as to their specification, EN1A, EN1A leaded, GCO(good commercial quality), CZ121, HE30, etc. I do hope other suppliers will take note!

For model makers who require materials not normally available to industry, such as some small sizes of copper tube, Maidstone Engineering Services have these made specially. For the non model maker who is probably more likely to demand raw materials in larger sizes, the range listed is good. This typically includes, Steel EN1A up to 4 in. dia, Flats GCO up to 1/2 in. x 4 in., 1/2 in. x 2 in. etc, Aluminium HE30 up to 2 in. dia. and Brass CZ121 up to 2 1/2 in. dia. They will also make an attempt to supply sizes of materials not listed in the catalogue.

Apart from the wide range of bar

materials, sheet materials are also supplied, in addition to the more usual brass and copper, sheet steel and aluminium are listed. Those readers of *M.E.W.* who are frequently pushing for the magazine to go metric, will be disappointed to learn that metric sizes are not stocked, apart from a few exceptions. However, one cannot blame Maidstone Engineering Services, apparently there is no demand for it. Where do those metrically minded readers get their materials? (*Perhaps they may like to write and let me know, except of course for those fortunate people who live in Europe, outside the U.K. - Ed.*)

Small tools stocked

Small tools listed comprise a good range of drills, taps, dies, end mills, slot drills, reamers and files etc. A very good buy for those with an interest in such items, are the dividing plates supplied. These are of the punched variety which, using modern CNC production techniques, achieve a high degree of accuracy at a very reasonable cost. Four plates, having 24 sets of holes in total, ranging from 24 to 66, cost around £32.00 for the set, including VAT, see photograph.

Catalogues

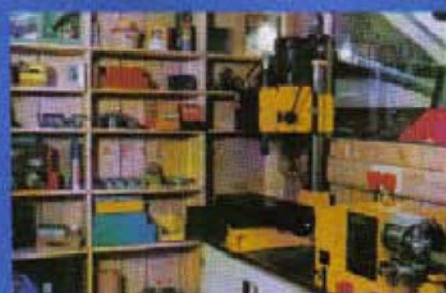
The catalogues available are issued twice a year and can be had by sending £1.00 or 4 first class stamps to the address below. The catalogue includes a map of the area making finding them not too difficult for callers, for whom adequate parking is available. Opening times are 9am to 5.30pm Monday to Friday and 9am to 4pm Saturday.

For further information, send to, Maidstone Engineering Services (Sales), 50 Hedley Street, Maidstone, Kent, ME14 5AD. Tel 0622 691308. Fax 0622 687216.



IN OUR NEXT ISSUE!

Coming up in the JULY/AUGUST issue No. 24 will be:



We visit a brand new workshop, full of new ideas.

Some thoughts on the methods for the measuring and marking out of angles.



Contents may be changed

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LAPS AND LAPPING

Lapping is an operation which is not carried out too often in the home workshop, probably out of a lack of knowledge of the technique. It requires only a minimum of simple items to be made, and reasonably inexpensive equipment. Alan Jeeves lets us into the secrets of this process

Most owners of a home machine shop will, no matter whether they are exponents in model engineering, or classic motorcycles, or any other activity demanding the use of a metal working machine shop; gratefully acknowledge that whatever industry renders obsolete by way of tools and equipment, often makes such process available to them at affordable prices (the shaping machine is a perfect example).

As well as machinery, processes also become outmoded and are replaced by more advanced and accelerated methods of arriving at the same result. One such process is lapping, and whilst I am aware that lapping machines are still produced and operated today, generally speaking the practice of lapping is no longer engaged in by the jobbing engineer. However, lapping is an very useful process to be familiar with; as any working gunsmith will attest. I hope to demonstrate that you can add to the flexibility of your home workshop, and accuracy of working methods, without spending too much of your funds and also without using up a great deal of your precious space.

One of these motor cycle devotees, himself a machinist by vocation, spent some time recounting to me how he had "lapped" a cylinder head by rubbing it on a piece of glass which had some grinding paste spread on it; the fact occurred to me that the whole principle of lapping was being eradicated as time passed by. I guessed that, whilst he was highly gratified by his efforts (the cylinder head was replaced and the engine performed satisfactorily), the same result would doubtless have been accomplished had it not been "lapped" at all.

First principles of lapping

One of the fundamental principles of lapping is that the lap must be made up out of a softer material than the work to be lapped. This being so, all that had happened to the (cast iron) cylinder head

was that it had, as a matter of fact, been turned into a lap itself. In the following paragraphs and illustrations I will endeavour to show why this happened. I will also attempt to outline the basics of lapping and, hopefully, encourage home craftsmen to attempt to enhance their own achievements by taking advantage of the this process. There will, I fancy, be many people who read this magazine who are already adept at lapping and own a comprehensive assortment of equipment.

I hope I can tempt these artisans to put pen to paper and chronicle their encounters and accomplishments. I, for one, never weary of harvesting more information and knowledge on the subject.

I was browsing through an engineering journal from 1909 when a letter published in it caught my attention. An American gentleman alleges to have lapped $\frac{1}{16}$ in. (4mm) keyways in six hardened milling cutters by substituting a power hacksaw blade with a suitable lap and setting the saw running at 'double the usual speed'. Alas he fails to tell us how long it took. Lapping and honing are two similar processes in that very small amounts of metal are removed at a time by the abrasives until the sought after finish or dimension has been attained.

The difference between the two processes is that the lapping process is carried out using a metal lap which has been charged with abrasive, whereas when honing the abrasive is in the form of a stone, indeed the word hone is derived from the Old English word *han* which means stone. As a rule, much more honing

allowance (up to 2.5mm in certain cases) can be left than the lapping allowance which will seldom be more than 0.05mm.

Honing machines, however, will be uncommon in model engineers workshops and honing will ordinarily be confined to the finishing of cutting tools with one of the extensive selection of abrasive stones which are used by hand.

It should be noted that lapping can be carried out on both hardened and unhardened work, remembering that the lap must always be made of a softer material than the job.

Choice of materials for laps

Any laps which are necessary in the workshop will have to be made up by the craftsman himself. One or two flat laps may be found on the occasional secondhand tool stall but it should be generally regarded that if any lapping is contemplated, tooling will have to be home furnished. Therefore we will deal with the option of materials pre-eminently as the same principles apply to all types of laps we are likely to need to make.

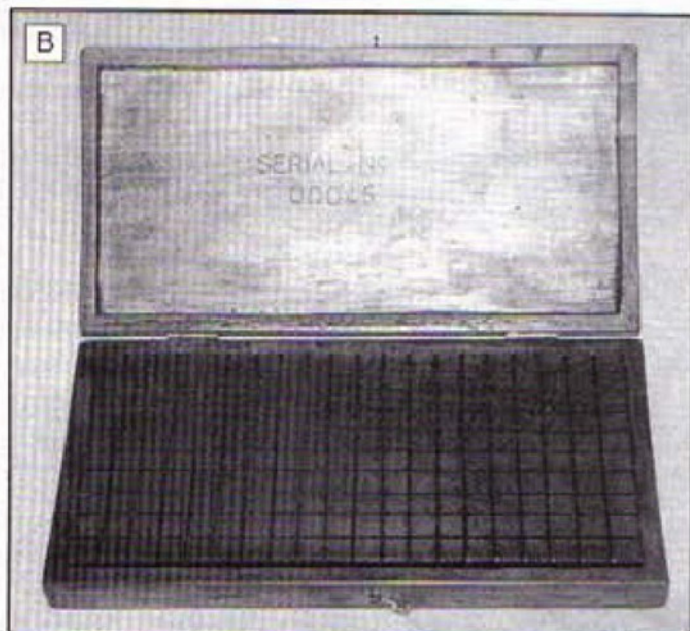
It has already been mentioned that the lap should be made from a softer material than that of the job being crafted. This should come as good news as it is realised that soft laps should be easily machined in the lathe, shaper, or milling machine or hand worked at the bench. Laps are quite easy to make. By far the most favoured metal for laps over the years has been cast iron. It is fairly easy to obtain in scrap form and old bearings and bushes are especially useful. Soft, close grained cast iron will charge easily with abrasive and will always produce a good finish, therefore it is safe to say that this should be the first choice of material for most laps.

If a large lapping allowance has been left, copper will be found to be the most suitable material for 'rapid removal' of stock. It can be charged with abrasive very easily indeed and it can be readily seen as the abrasive becomes embedded in the surface as the colour changes to grey. Laps made this way will cut faster than cast iron ones but will not generate as fine a finish for the same grade of compound. Brass, and aluminium are also much used and even mild steel can be utilised if nothing



A: A selection of laps and abrasives:-

1. Cast iron roughing lap. 2. Copper roughing lap. 3. Cast iron finishing lap. 4, 5 & 7. Examples of commercial grinding paste. 6. Abrasive powder (sold for cleaning spark plugs).



B: Cast iron flat lap
- roughing side.

else is available; it is soft enough to be charged with abrasive but won't have the same self lubricating attributes as cast iron. Another soft metal which is easy to use is lead. This can be employed for the making of the expanding type of internal bore laps as we shall see later. Lead is exceptionally easy to charge with abrasive but is easily damaged if knocked or dropped. Hardened steel, glass and the like are out of the question. They will be difficult to charge and will only transpose the abrasive into the job instead of cutting it.

The home workshop owner is more likely to make his laps from whatever material he has to hand, but it is prudent to obtain any material which is going cheap and which may come in useful in the future.

Hardwood has been known to have been used to make up laps in the past. The end can be split and a wedge made use of (for internal laps) to expand the diameter. These are fine if all that is required is a polished finish, but due to the fact that the wood is compressible, accurate dimensioning of holes is more difficult. Wood is, however, worth considering as it is usually readily available and easy to work.

Lapping Compounds

When the material has been selected, and the lap produced, it will have to be charged with a suitable abrasive for the job in hand. It is not a good idea to charge a lap with dissimilar grades of abrasive for different jobs. From this it will be clear that two (or more) similar laps will have to be made for roughing and smoothing.

The grade of compound chosen will depend upon the quality of finish required by the individual; it must be said that a very wide choice and quality indeed is available to those who endeavour to track down suitable sources. Results can be astounding.

I suppose the simplest form of abrasive available is the one which can be bought at any motorist's accessory shop for re-grinding inlet and exhaust valves in internal combustion engines. It is quite cheap, ready prepared and comes in the form of a twin tin - coarse abrasive at one end and fine abrasive at the other. I have a cast iron flat lap (photos B & C) which is used for the vast majority of my flat plane

work and which is double sided, one side for roughing and the other side for finishing. It is charged exclusively with this type of compound which is very convenient to use and is to be recommended.

After this will be the carborundum compounds which are usually available in lapping grades ranging from 70 to 600, 70 being the coarsest, 280, 320, 400, 500, & 600 being known as flour sizes. Coarser grades down to 6 are obtainable, but need not concern us here. Jewellers rouge and diamond dust can also be used if superb quality finishes are required. Brazilian bort (sometimes spelt boart or bortz) are extensively used as a diamond compound and some brands of diamond compound are supplied in paste form and are contained in a syringe which discharges a precisely controlled quantity in the interests of economy, due to the expense of such products. If the diamond compound is supplied in dust form it has to be carefully mixed with light oil before being applied to the lap. The method of application will be covered later under the

heading of the appropriate type of lap.

So far we have dealt with the materials which are suitable to make a lap, and suitable abrasives for the process. We will now consider the different types of lap which can be produced for different types of work. We will be looking at laps which come under three main categories, flat laps - for flat plane surfaces; internal laps - for bores; and external laps - for finishing outside diameters, the latter two being cylindrical laps.

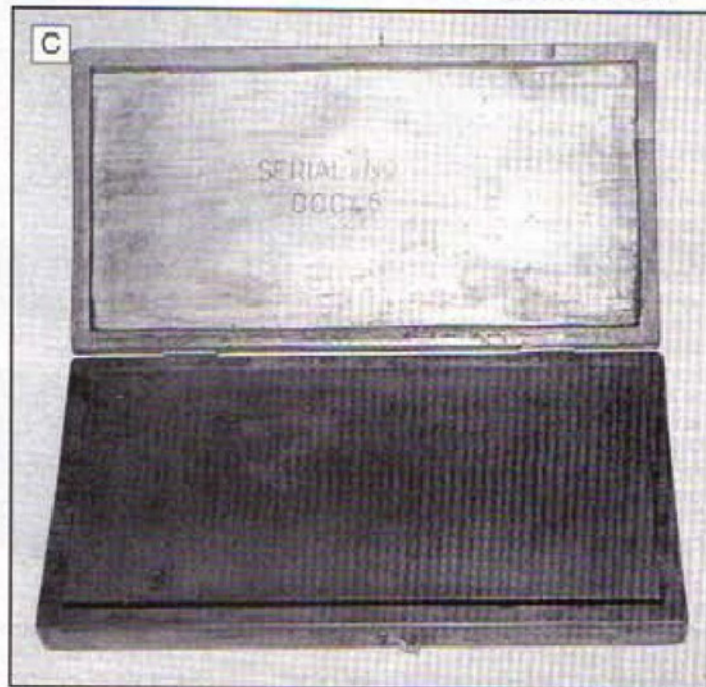
Flat laps

Flat laps are extremely helpful to have on hand in the workshop. If a single flat lap of reasonable size is made, it will probably cope with most jobs the engineer will encounter. Extra laps can be added to the range if specialist work is to be undertaken, a new lap being made for each grade of abrasive.

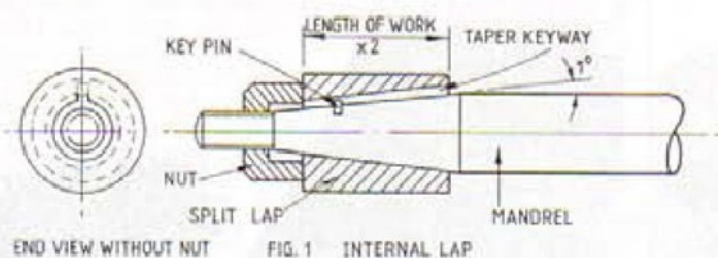
The flat lap mentioned earlier (photo's B & C) was produced from a piece of scrap cast iron which machined up to about 250 x 125 x 12mm thick. Saw cuts were made in one face at 12 mm spacings both length ways and laterally, approximately 1.5 mm deep, these being there to enhance the cutting action of the lap when roughing out or 'blocking down' as this part of the process is known.

The opposite face was surface ground, finally the 'chequered' face was also surface ground to complete the job. A wooden box with a hinged lid to protect the lap when not in use was made. The laps were then ready for charging with abrasive. If you don't have access to a surface grinder it is worthwhile getting someone to grind it for you or, as another recourse, the surfaces can be scraped flat if you are able to do this (photo D). Either way the faces must be as flat as practicable.

The abrasive compound opted for can now be forced into the surface of the lap. On my prototype I have used the ready prepared motorists grinding paste as already defined but emery powder is extensively used, mixed with light oil to make a paste. The grade of abrasive for the blocking down lap (with the saw cuts in) can be around 100, this is classed as fine



C: Reverse side of
B, cast iron flat lap
- finishing side.



END VIEW WITHOUT NUT FIG. 1 INTERNAL LAP

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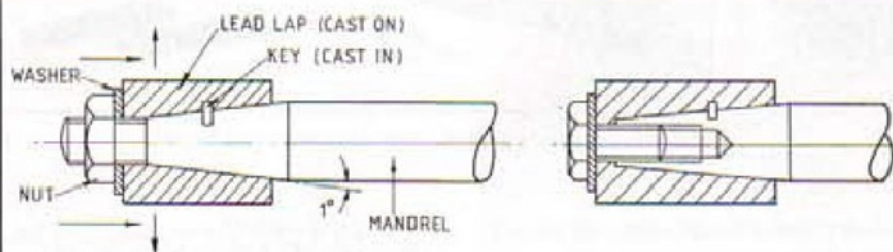


FIG. 2 LEAD LAP FOR INTERNAL WORK (WITH ALTERNATIVE SCREW ARRANGEMENT)

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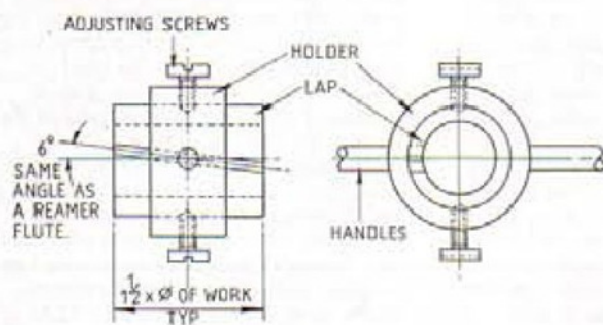


FIG. 3 EXTERNAL LAP HOLDER

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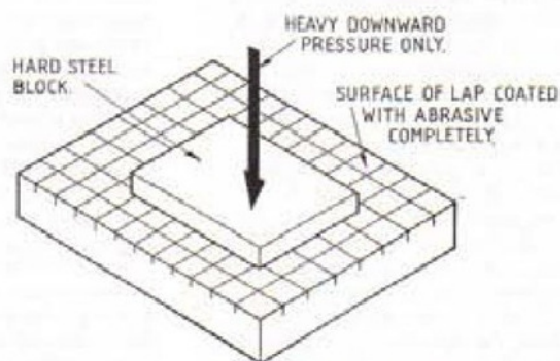


FIG. 5 CHARGING A FLAT LAP WITH A HARD STEEL BLOCK

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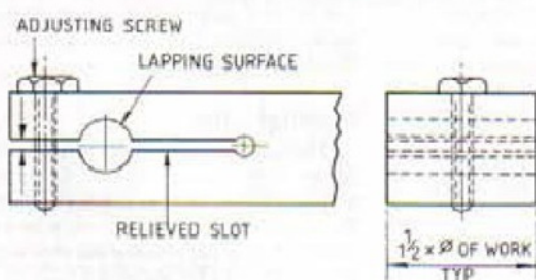


FIG. 4 EXTERNAL LAP FOR SMALL WORK

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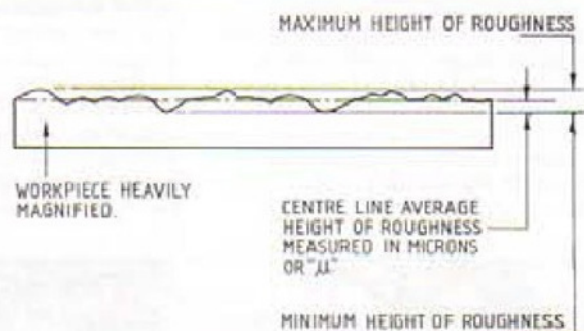


FIG. 6 THE MEASUREMENT OF SURFACE FINISH

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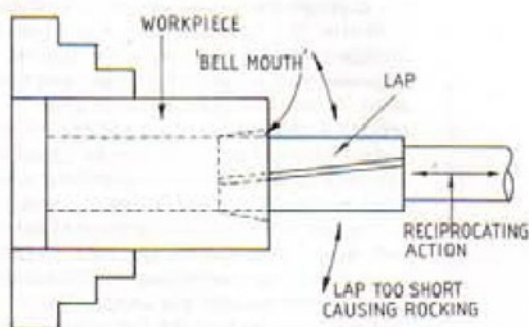


FIG. 7 THE EFFECTS OF 'BELL MOUTHING'

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A charging roller

A simple way of making a hardened roller for charging laps with abrasive compound is to mount a bearing journal onto a suitable holder with a good handle. The wider the bearing the better. When selecting a bearing for this purpose, the type which has metal or plastic shields over the cage should be considered preferable as this type will not allow abrasive 'into the works'.

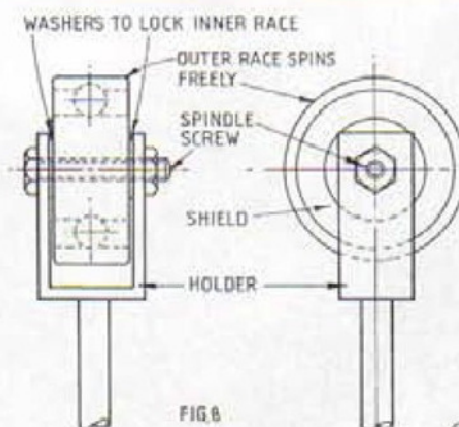


FIG. 8

©

carborundum. For the finishing side around 240 grade can be used; considered a very fine carborundum powder. Of course, different grades can be used if preferred but those mentioned will give good results for general duty work. I fashioned a set of precision parallels which were hardened and ground (photo E) and then finished on this lap. They would have been quite good enough just ground, but lapping them made them into an admirable set of high quality parallels which are a pleasure to own and use.

The machining on the lap was executed on a vertical milling machine but laps can be produced on the lathe. They can be made circular if this is more useful, or any other shape to suit the work on hand. I made the small laps, in photo A, 75 mm diameter to lap some slip blocks which I had made to replace those missing in a set of blocks I had recently purchased. I consider it better to use a smaller lap for smaller work.

The abrasive compound which has been



D: Part completed flat lap being scraped flat.



E: Slip blocks and parallels - typical examples of flat lapping.

prepared has to be forced into the surface of the lap and some 'old hands' contend that this should be done by covering a hardened block of steel with the compound, placing it on the lap and pressing firmly downward (**Fig. 5**), no sliding or rubbing action being permissible. This process is repeated until the whole of the surface of the lap is covered with abrasive and develops into an even grey colour all over. Experience soon tells you when a lap is properly charged and it 'looks right'. Experience is the keyword in all lapping operations. I find the charging of my flat laps by this means slow and tedious so I use a 30 mm diameter hardened steel roller which was once a mandrel (**Fig. 8** shows a method of making one from a roller bearing). I use this akin to a bakers rolling pin, applying the abrasive sparingly to the lap itself and rolling it out, taking care to cover the surface evenly. I have used this method for years and it works fine for me. Overcharging should be avoided at all costs. If excess abrasive is used, the component will roll round on the fine grains and only gets scratched instead of cut (as we saw earlier with the piece of glass). Once it has been charged to the craftsman's satisfaction the lap can be washed with petrol or solvent to remove any surplus abrasive and the lap is ready to use.

The work piece to be lapped is simply

placed flat on the lap and is moved around on the surface, exerting just enough pressure on it to prevent it from 'wringing' itself to the lap. This is made easier by the fact that lubrication is used, this is normally paraffin. Petrol is a good lubricant, but it evaporates quickly. The work piece must be moved over the whole surface of the lap, and not merely one concentrated area, in order to stimulate even wear on the lap. A 'figure of eight' action is a dependable way to go about this. As the work progresses, the results will clearly be seen on the surface of the work. Smooth spots will appear where the job touches the lap and these spots will gradually grow larger until the whole surface is 'dead flat'. But be warned! lapping is a slow laborious process. It may be worthwhile to note that the copper lap (**photo A, No. 2**) was surface ground on a magnetic chuck. Copper being non-magnetic, a piece of mild steel was 'superglued' to the base, to give the desired magnetic effect. Another type of flat lap which is worth considering is a rotary flat lap. This consists of a disc, which is of a size which can be swung in the lathe, and is charged with abrasive (**photo F**). A small work rest is fitted where convenient and as the rotary lap revolves, the work is placed on the rest and is lapped by simply moving it from the centre of the disc to the outward edge and back again.

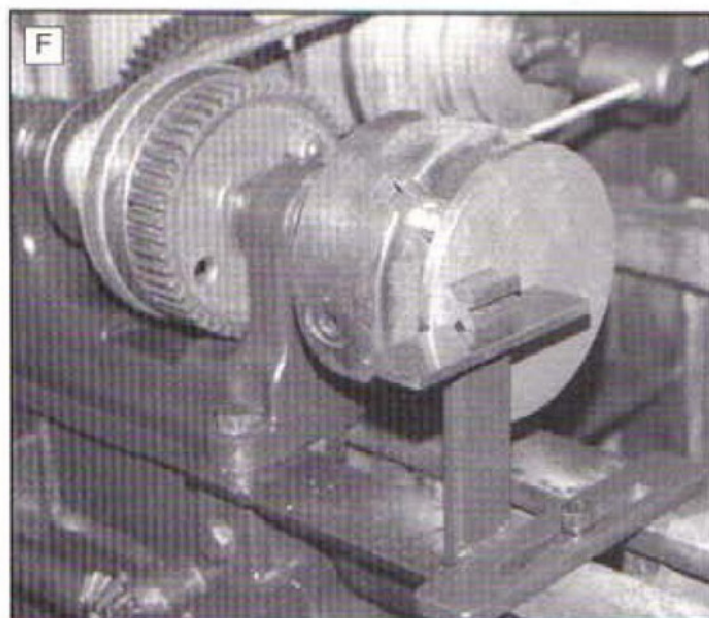
By using this method even wear of the lap is assured and it is much easier on your wrist. This type of lap is never 'cross hatched' with saw cuts. Plainly the face of the disc, when set up in the lathe must run true and a small step can be machined on the outside diameter forming a second and protected (from damage) face about 5mm wide. This acts as a 'clocking band' where the dial test indicator can be used. To charge this lap with abrasive, a small, hardened roller can be used to force the compound into the surface.

The surface finish of an article which has been flat lapped can be compared with a set of 'surface roughness comparison standards' in accordance with BS 1134 in which sample gauges can be found having a lapped surface finish of 0.2 microns (8µin. CLA); 0.1 microns (4µin. CLA); and 0.05 microns (2µin. CLA) - where a micron is equal to one millionth of a metre and 1µin. is equal to one millionth of an inch. CLA abbreviates 'Centre Line Average' height of roughness (**Fig. 6**). These finishes can be improved upon even further by using the flour sizes of abrasive and also the diamond grades.

Internal Laps

These laps are used for the fine finishing of bores. Superior finishes can be achieved and, of course, to truly precision dimensions. But remember a bore can only be as accurate as your measuring equipment. If you happen to be lapping a bore to a go/no go plug gauge, extreme accuracy is possible.

The type of lap I favour for use in the lapping of parallel bores is that which is shown in **Fig. 1**, and consists of a bush having an outside diameter of equal size to the bore which is to be lapped, less about 0.05 mm. The bore of the bush is tapered and locates on a mandrel which is also provided with a matching taper as can be seen. The bush is split diagonally (at around 6 deg.) along its length and as the nut is tightened onto the mandrel, the bush expands. The bush is the lap and the same rules apply, regarding the use of materials, as the flat laps. The lap is then charged with abrasive by rolling it on a hard steel block which has been coated with abrasive paste. Continue until it is uniform in texture, again as with the flat lap. A sheet metal worker friend supplied me with a piece of discarded blade off a large guillotine which is an ideal tool for charging these laps.

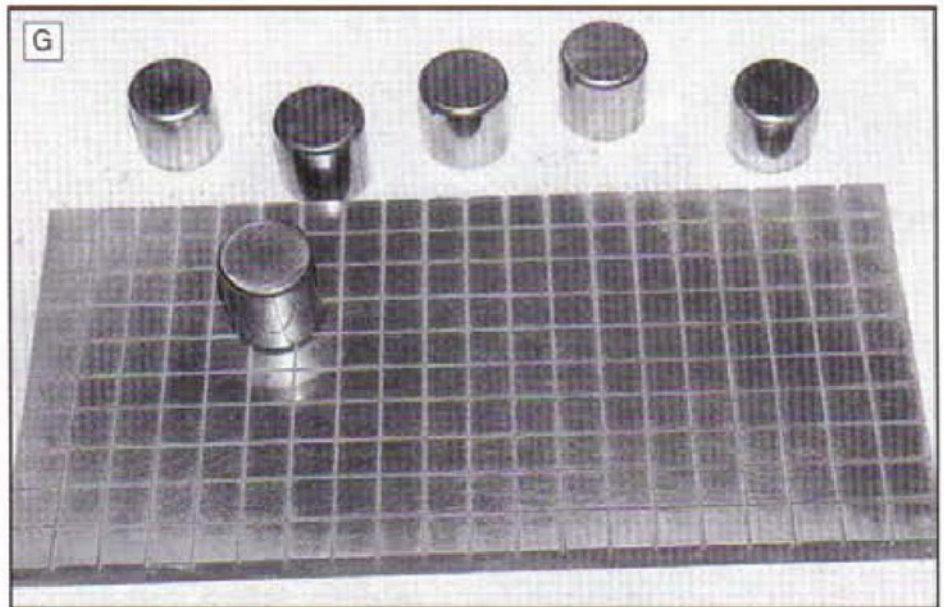


F: Rotary flat lap and work rest fitted to the lathe.

The component which is to be lapped will have a bore which is undersize of the finished size in order to leave an allowance for lapping. This allowance will vary according to how good a machined bore can be achieved, the better the machined finish the less allowance and therefore less lapping.

If the bore can be accurately reamed undersize, with say an expanding reamer, only about 0.01mm need be left but if it is bored with a boring bar more stock will have to be left as a lapping allowance. Results in excess of 0.4 microns (16 CLA) are possible when producing a reamed finish. If the allowance is greater than in the region of 0.05 mm it will be a very time consuming operation in order to achieve the desired dimension. The bore to be lapped should also be as parallel as possible. The lap is now expanded until it just touches the bore to be lapped and, with the aid of plenty of paraffin, the lapping proceeds by gradually expanding the lap as required until satisfactory results have been obtained.

The lap may be revolved by hand by clamping, for example, a tap wrench or lathe carrier onto the mandrel and turning it in one direction only whilst the job is held in the lathe chuck. Alternatively the mandrel can be held in the lathe chuck and the job be hand held as the lathe is run at a slow speed which will establish a cutting speed of around 30ft/min $12 \times 30/\pi d$ and the job reciprocated on the lap. This approach is, perhaps, the better of the two for most classes of work but care must be taken to hold the work loosely so that it is



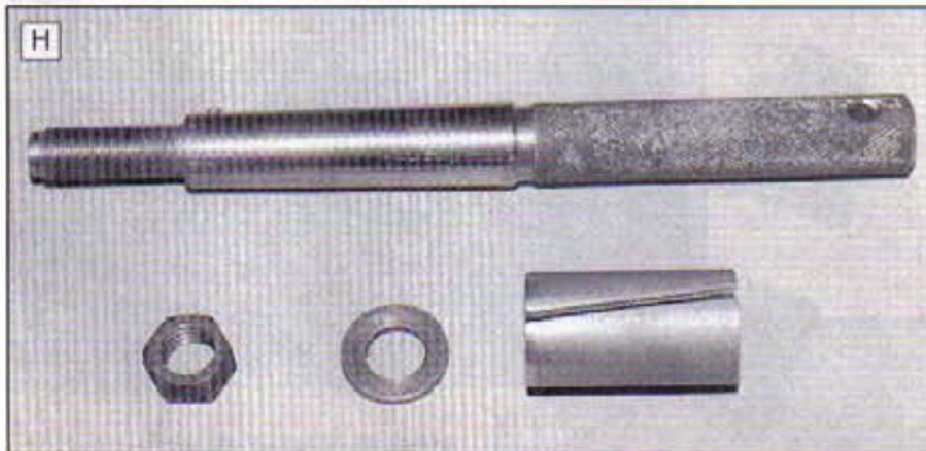
G: Lapping the faces of roller bearings.

with the length of lap.

Another type of internal lap is one which is made from lead (**Fig. 2**). A tapered mandrel is made and a key formed in it, say a tight fitting pin. The mandrel is drilled and tapped and a lead cylinder cast onto it with a screw and washer fitted in the tapped hole. The lead, when cool, is turned to the required diameter on the lathe and charged with abrasive. To expand the lap, the screw is tightened which has the effect

of compressing the lead thus increasing the diameter. The pin or key prevents the lead from spinning on the mandrel. This form of lap will not, however, last as long as the one formerly described.

It is, in addition, possible to lap tapered or conical bores, but the lap need not be adjustable. A metal plug is made, the same taper as the job in hand, which is longer than the bore of the job and larger than the major diameter. It is charged with abrasive in the usual manner and the lapping can proceed. The fact that the lap is tapered means that a reciprocating action is not possible, therefore care must be taken to ensure that the lap does not seize in the work. Also, if any scoring takes place it will put an annular groove in the work which will be difficult to remove. In the parallel bore, as the lap moves in and out, a different part of the lap is in contact with a particular section of the bore being lapped at all times, countering any score marks. For this reason a secondary, and finely charged taper lap may have to be used. It should also be borne in mind that this type of lap must be made accurately to the taper of the bore required. Plenty of lubrication will also be needed which should not contain any grit which may get trapped between the lap and the job. It might be a good idea at this stage to include a reminder that, as abrasive material is being used, the lathe bed should be protected and properly cleaned when the work is completed.



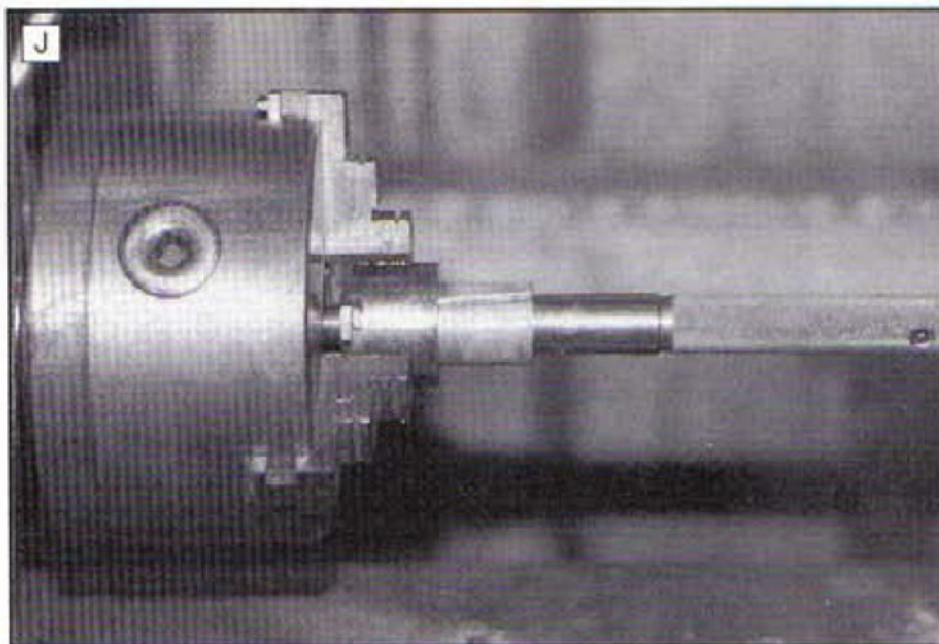
H: Component parts of internal lap.

able to spin out of the hand easily if the job snatches. A glove (make sure there are no loose threads which can catch up on the work) may also be worn to protect the hand if the job spins; this also helps to shield the hand from the heat which is generated by this process.

The friction between the tapered bore of the lap and the taper of the mandrel should be sufficient to prevent the lap from spinning on the mandrel during use, but if spinning is encountered, a small pin or key is simple to incorporate into the design. The overall length of the lap should be about twice as long as the bore to be lapped in order that it may be reciprocated and still remain parallel with the job. If the lap is too short there is a real danger of 'bell mouting' arising on the work piece (**Fig. 7**). Also, the lap will be stored for future use when the work has been completed and there is no telling what length the next job will be, so be generous

I: Internal lap and tube of diamond compound.





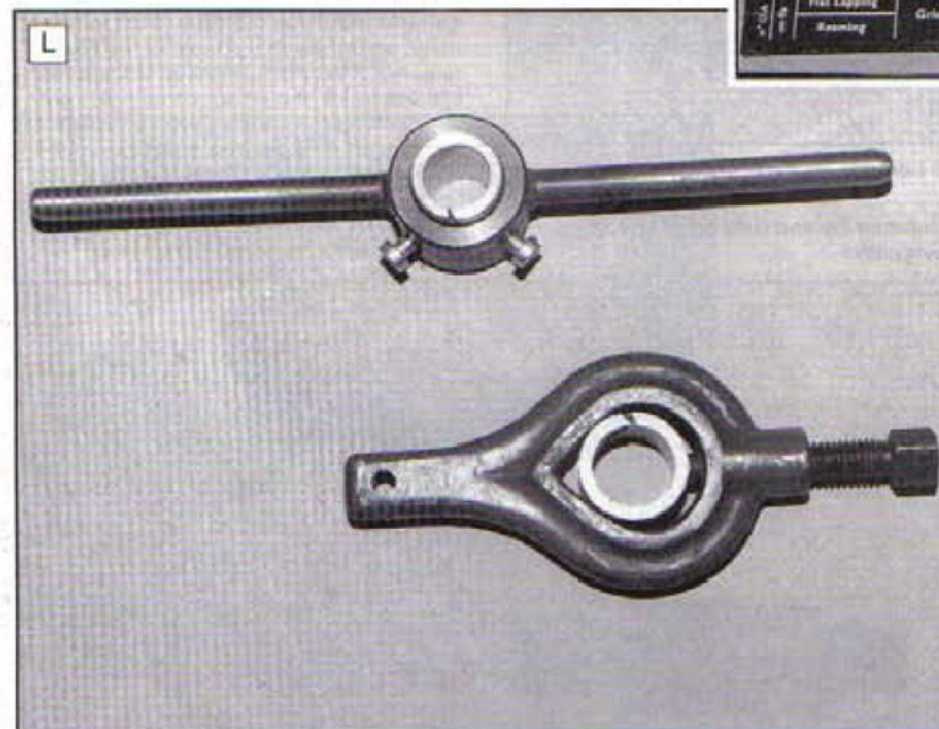
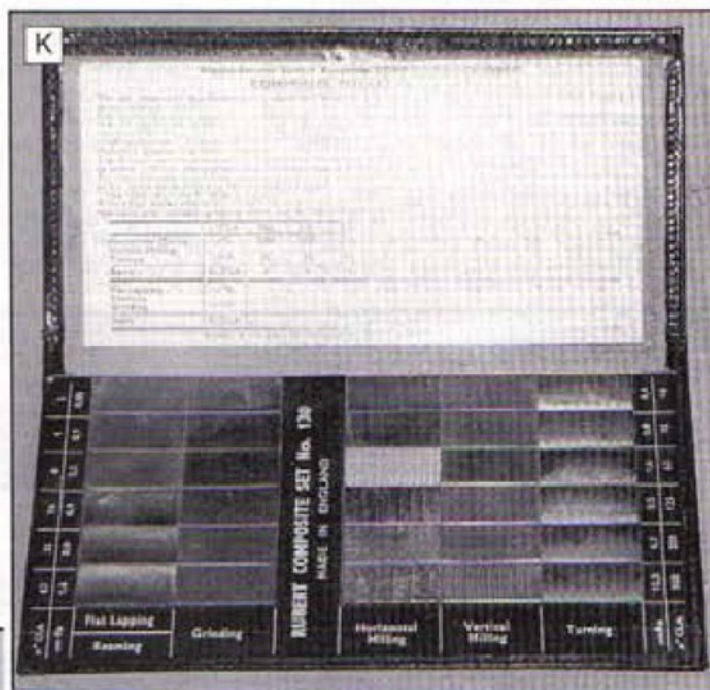
External laps

I should think the definition of an external lap is 'the opposite of an internal lap'; this is exactly correct. The critical part of this lap is the bore which must be produced with a good finish and parallelism. The outside diameter, however, need not be tapered in order to adjust the cutting surface as alternative and easier methods are available. The simplest of these is a diagonally split bush (again about 6 deg.) which has been bored 0.05mm or so longer than the finished diameter, charged with abrasive, and held in a common lathe carrier. The carrier is the driver as the job revolves in the lathe chuck, and a twitch on the clamping screw closes up the lap to take a tiny amount more off its diameter. It couldn't be simpler. If lapping is thought of to be a regular method of finishing work though, a proper set of holders may be wished for by

J: Internal lap in use - component in lathe.

K: Surface roughness comparison standards.

L: External laps and holders.



the discerning craftsman. A good example is shown in **Fig. 3**. This type of holder resembles a die stock and makes for easy control of the lap. Sometimes these holders are made with only one handle but I prefer the two handled kind as it makes use of the mechanical advantage of the 'couple' and advocates even pressure on the lap, which helps it to cut evenly. I usually make my external laps 1½ times the bore diameter long. For example, if the shaft to be lapped is 20mm dia., the lap will be 30mm long. Once charged with abrasive, the lap is contracted onto the job and reciprocated and revolved simultaneously just as is the internal lap. It must be stressed that if a shaft is bent it is no use trying to lap it. Cylindrical lapping will in no way alter the form of a component, only the diameter and surface finish, unlike flat lapping which will take out any (slight) bowing which has taken place. Another type of external lap is shown in **Fig. 4** which is very useful for dealing with small diameter work. The lap is hand held as a 'lump' and the same

principles apply to making and using these as to other external laps. They are very easily and quickly constructed.

A suitable method of charging external laps is to use a hardened roller or pin which is smaller than the bore of the lap. Abrasive compound is spread over it and it can then be rolled round the lap until suitably charged. Any surplus abrasive can, once again, be washed off with paraffin. As you can now see, laps can be made up to your own individual requirements and, after use, can be carefully stored for future jobs.

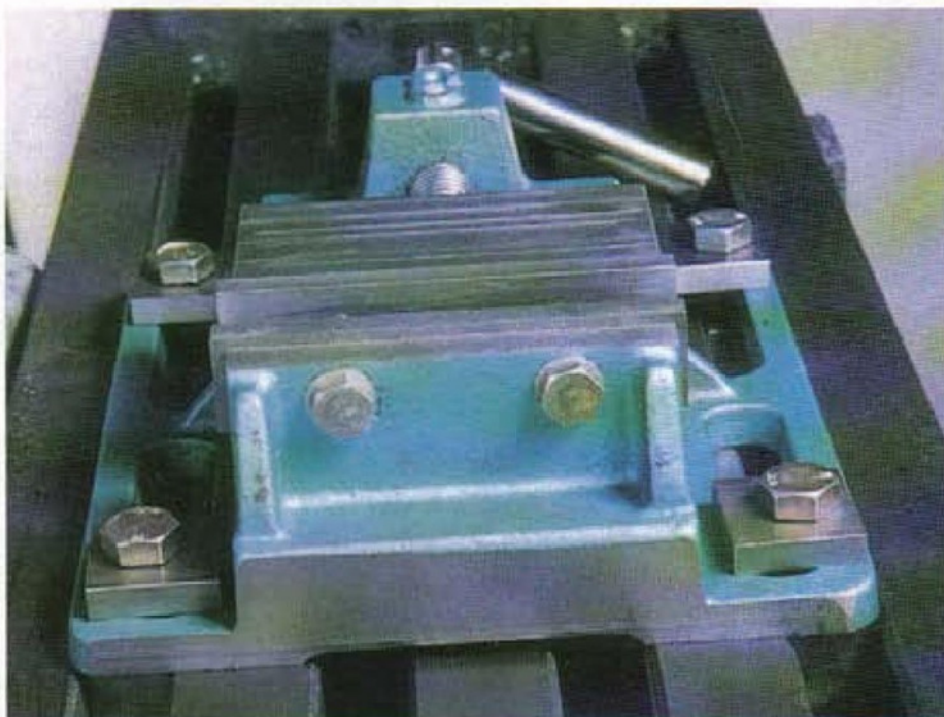
Don't be afraid to experiment with laps, as this is how their merits are discovered. There is no substitute for experience in this fascinating area of the precision finishing of surfaces in the home workshop. Don't forget also, that although there are no visible sharp edges to do the cutting on laps; when they are run in the lathe (or any other machine) lubricant can be sprayed about. It is a wise precaution to wear eye protection as a safeguard against injury.

UNUSUAL TEE NUTS

An idea for some unusual tee nuts which may occasionally make mounting items on the machine table just a little bit easier

The unusual tee nuts illustrated in this article came about as a result of endeavouring to fix the modified drilling vices, described elsewhere in this issue, to my drill/mill table. The problem came about, despite the generous cast in fixing slots in the vices, as a result of attempting to bolt them to the milling machine table using only a simple tee nut and bolt.

In the case of the smaller vice, the slots were just too close to line up with those on the machine table. Whilst those in the larger vice were only just too far apart. After considering many possibilities, none of which appealed to me, the thought of producing tee nuts with the hole off centre came to mind. The off centre tee nuts did not cure the problem completely; there was still an error of around 0.25mm, this was overcome by filing small recesses in the



Showing how the difference in pitch of the tee slots with those in the vice, are overcome by the off centre tee nuts.



The four special tee nuts with suitable heavy duty square washers. Note the holes are also off centre in the washers.

edge of the slots at the appropriate positions. These recesses can be clearly seen in **photograph 18** in my other article, which dealt in some detail, with the conversion of the drilling vices into tools suitable for the milling machine..

Whilst making the tee nuts, a process which requires no explanation, it occurred to me, that on occasions in the past I had found a problem when the position of the stud/bolt was just in the wrong position, perhaps by a millimetre or two. On this basis, perhaps they will find use in other applications in the future.

For this reason I have separated this brief explanation from the main article, on the basis that readers may like to make a few for general use, whether or not they have the problem as described in the main article. It is probable that the smaller the work table the more likely these nuts will prove useful on occasions.

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The larger of the two vices prior to modification, also showing the block of cast iron to be used for the new moving jaw.

FROM DRILLING TO MILLING VICE

The cost of a commercially available milling vice will, for most readers, be more than can be justified, it is also likely to be larger than required. This vice, developed from a readily available and cheap drilling vice, will make a useful alternative for light duty applications at a fraction of the cost

Reference to any tool suppliers catalogue in search of a milling vice will invariably result in vices being offered with a £100.00 plus price tag. Even the so called economy suppliers do not appear to list a milling vice at a much lower price. The problem is, that vices on offer are of an industrial calibre, and of a type designed for horizontal milling, an operation which invariably places heavy demands on the vice in terms of robustness. Purpose designed vices may also be larger than is necessary in most cases, unless the machine on which it is to be used is larger than average.

Perhaps one exception is the very common tilting vice; while these are quite robust, they still have a short jaw length and are likely to suffer from jaw lift. Their capacity in terms of jaw width and opening is limited, and will be even more so if the jaw is replaced with a longer one to attempt to minimize lift. One could make a milling vice, to keep costs down, from castings available from such sources as The College Engineering Supply, but this would be comparable to the industrial vices and be too large for all but the largest

of vertical mills, smaller so called toolmakers vices may be better.

I did see, on the stand of one supplier at a recent exhibition, one small vice with the outward appearance of a milling vice, and a much more affordable price tag. On closer examination, what looked to be a jaw with long slides, turned out to be a jaw with the support system common to the cheaper vices, the extension being merely an apron to keep swarf away from the lead screw. Of all the items on offer to the home workshop, the vice probably has the widest range of qualities available; the worst are without doubt very poor.

It must be considered essential to inspect a vice carefully before purchase. The temptation will be to attempt to make do with a vice intended for drilling duties, but whilst the best of these may be adequate for some applications, it is not a good approach to take. However, the poorest of these will not be suitable, a typical example being that seen in **photograph 1**. The main reasons for it being unsuitable, are the short jaw length, and the very inadequate keep plate as seen in **photograph 2**.

Modifying an economy drilling vice

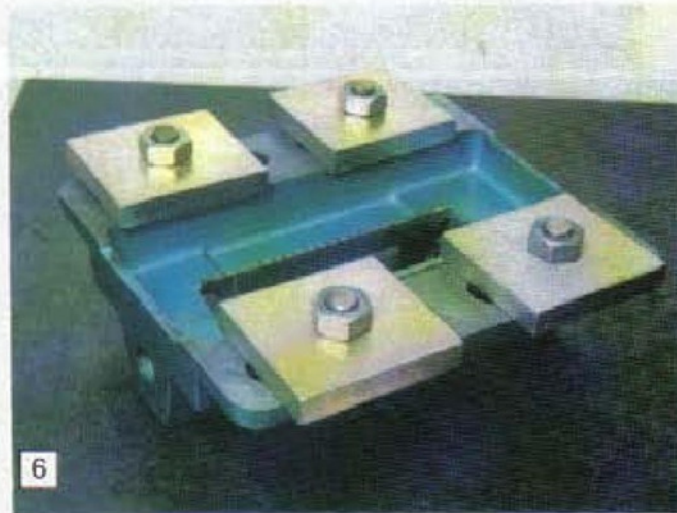
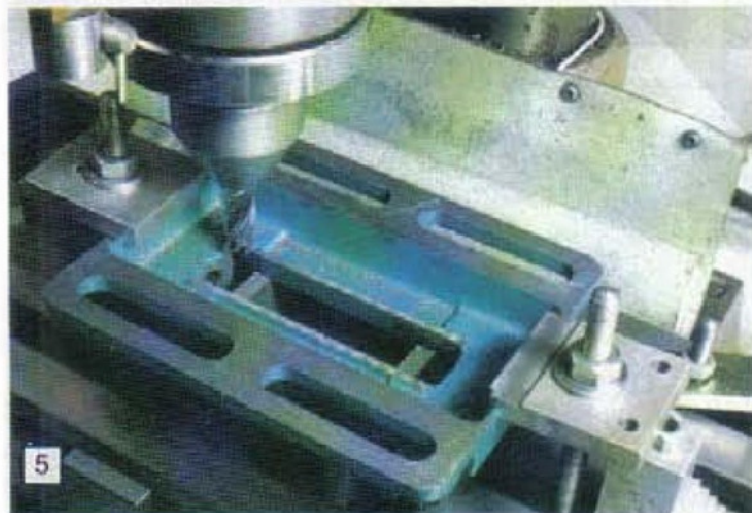
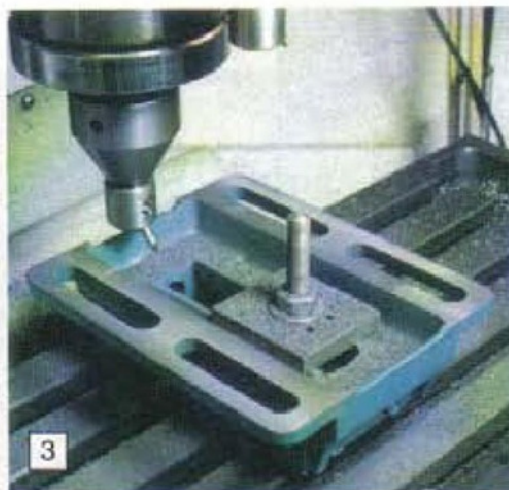
Even so, having two of these drilling vices available, consideration was given to the possibility of making changes that would permit their use for milling, at least for the physically less demanding operations. The smaller vice had a nominal jaw width of 75mm and an opening of around 70mm. Even with a longer jaw, the main requirement, an opening of 50mm plus should be possible, as a result it was decided to give it a try.

To arrive at a satisfactory conclusion a new jaw would be the main requirement, with some of the sliding faces re-machined to improve accuracy. The vice was dismantled and the main body closely examined. This had been machined in all the expected places, but even so had been painted all over, except for the top surface on which the moving jaw slid.

The first face inspected was that intended to rest on the machine table. The paint was largely removed by means of a scraper and, with this done, it was checked by placing it on a surface plate. Having been machined, I anticipated that this would be acceptable, unfortunately this was not the case. It had obviously been distorted by being badly held whilst machined, and when released had sprung back, resulting in a surface which was far from flat.

Minimum removal of metal

The casting was rather light in construction, therefore it was preferable



that any further machining would remove the minimum amount of metal, so as to limit reduction in strength. The surface on which the jaw slid appeared reasonably flat when checked diagonally with a straight edge, so it was decided to use this for mounting the casting for machining the bottom surface.

Also, by using this method of mounting the base for machining, any subsequent machining of the top surface would require very little to be removed. The casting was placed on two parallels and held in position with a plate, then machined using a fly cutter as seen in **photograph 3**. The amount removed was just sufficient to clean up over the complete surface.

With this done, the surface was tested on a surface plate using engineers blue and found to be almost satisfactory. After repeatedly scraping to remove high points and then testing again for a short while, a satisfactory result was achieved. It was now time to check if the top surface was true to the underside, **photograph 4** shows how this was done. Whilst the error was not great, a little over 0.02mm, it was considered sufficient to warrant machining the surface. To do this, the casting was mounted directly on the milling machine table and the surface very lightly machined using an end mill.

After machining the surface was once more checked, resulting in an indicated error of about 0.015mm. However, this test showed differing results depending on where on the surface plate the test was made, indicating that the plate was probably slightly hollow as a result of much use or, more likely, misuse by its previous owners.

With the two surfaces now machined and parallel, there remained the surface on which the keep plate slides to consider. This again had been painted and required to be scraped before it could be checked. The essential requirement is that these faces are parallel to the upper face. This was measured with a normal micrometer placed in position through the central slot.

The error found was more than could be tolerated and the faces had to be machined. Holding the base for this operation proved to be a problem, it first being machined as seen in **photograph 5**. This, not surprisingly, was a failure due to the casting distorting, due to it not being supported directly below the clamps. An alternative approach was necessary.

The method adopted

The second attempt was to add four plates onto the underside of the casting, illustrated in **photograph 6**, and then to be mount this assembly on two precision parallels as in **photograph 7**. The faces were machined again and this time the result was almost spot on. The error present, less than 0.02mm, could be eliminated at the final assembly stage, more about that later.

Next the slot along the centre of the casting was checked to determine if it was of equal width along its length. A little paint had found its way onto the sides of the slot and this was removed, again using a scraper. The slot's width was measured at points along its length and found to be adequately parallel.

It was decided that the outside face at the fixed jaw end should be machined, at

2: The totally inadequate construction of the larger vice below the base can be seen in this photograph.

3: The smaller vice; this is featured in all the remaining photographs. Here it is seen having the base re-machined.

4: Checking how parallel the upper face is with the base.

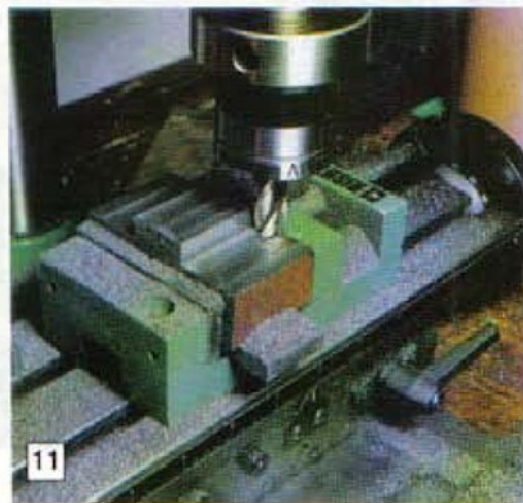
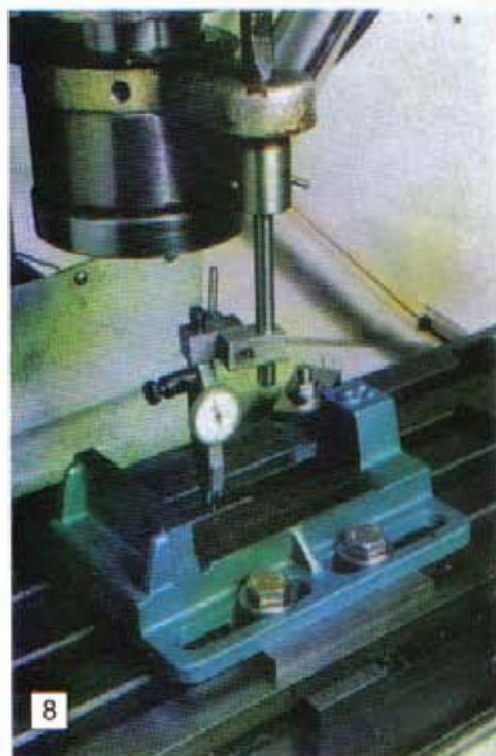
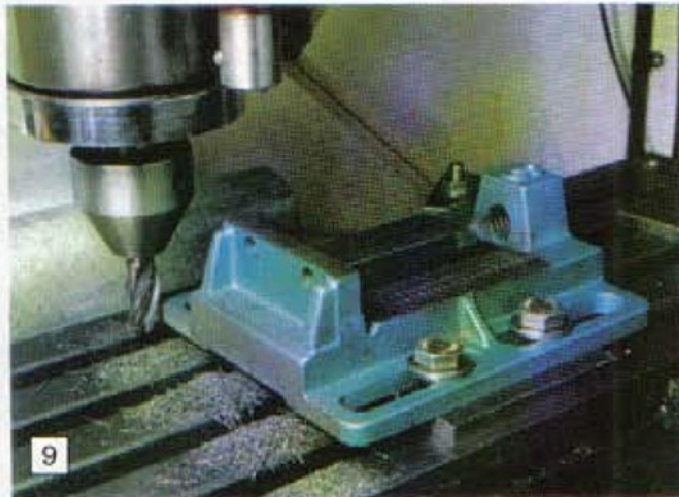
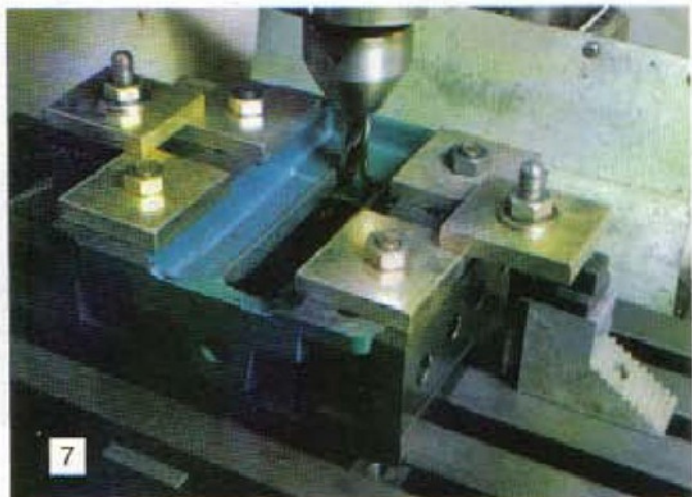
5: The initial attempt to machine the surfaces on which the keep plate slides. This proved unsatisfactory due to the casting being distorted as a result of the method of mounting.

6 & 7: Revised method of mounting to overcome problem of distortion.

its lower edge, as this would provide a reference face by which the vice could be positioned on the milling table using a square located on the table edge and the machined face. At this stage, the vice jaw which should eventually run parallel to this reference edge had not been machined, so it was decided that the face should be at a right angle to the slot along the casting. **Photograph 8** shows the casting being accurately positioned.

Unfortunately, when machining the front face, a hard spot in the casting was encountered which did the cutter no good. I should have taken a deeper cut but was attempting to remove as little as possible for the reason mentioned earlier. All other machining was on surfaces already machined and was done with ease.

Machining the edge is illustrated in **photograph 9**. It can be seen that the casting is raised to permit the cutter to machine to the lower edge without any danger of cutting into the machine table.



8: Setting up the base to run parallel with lengthwise motion of table.
9: Machining a reference surface for use when subsequently setting up the vice on machine table.
10: Initial shaping of jaw on a universal band saw.
11: The underside of the jaw being machined.

Moving jaw

Next it was the turn of the moving jaw and for this a suitably sized block of cast iron, shown in **photograph 1**, was obtained from The College Engineering Supply. This was first rough cut to shape on the band saw (**photograph 10**) to minimize machining required. This produced two small pieces of cast iron which may find some use at a later date, rather than lots of swarf. Incidentally, these blocks of cast iron (I had another for a second vice) machined with ease, no hard spots or blow holes being found.

There are two essential requirements for machining the underside of the moving jaw: the central portion should be a close fit

in the slot, and the two surfaces, either side of this, are machined to the same level. First machine both sides to the required depth, taking the final cuts without altering the down feed, and the central tongue just too wide, 0.1mm, for the slot in the base of the vice. Now progressively reduce the width of the tongue by around 0.02mm, at a time, testing at each cut until the two parts mate correctly.

Test each time at both ends and the centre of the slot until the parts mate, at least in one position. At this point, do not remove any more from the jaw. Machining the jaw at this stage can be seen in **photograph 11**, however, the jaw should be higher in the vice, as this will permit checking fit of jaw in base rather better than was the case with the prototype.

Now finally machine the height of the central tongue to be equal to the thickness of the appropriate section of the base. Any error in the height should be on the low side so as to initially make the jaw tight when fitted with its keep plate. The error in question should be no more than 0.02mm, any more than this will make the final fitting stage a long job.

Remove the jaw from the milling machine and, if required, lightly scrape the insides of the slot in the base at the appropriate positions until the jaw moves along its whole length. This should preferably be very slightly stiff rather than free.

Keep plate

Make a keep plate from a suitably flat piece of BMS strip, drill with four holes, and

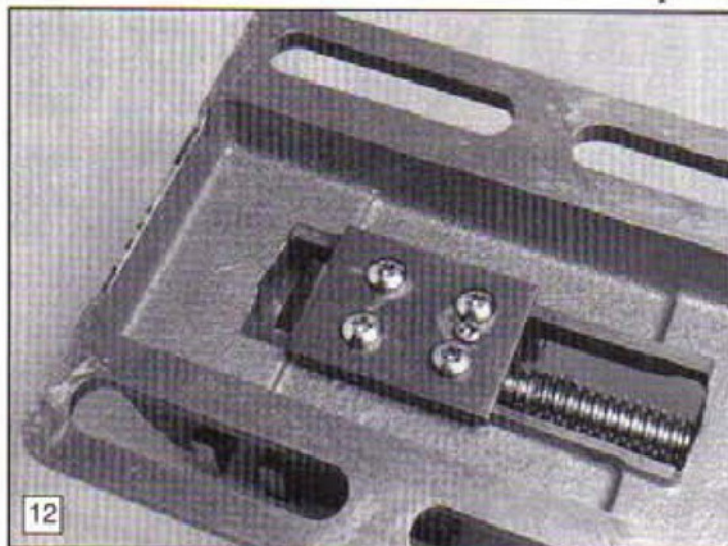
drill and tap the jaw to suit. The keep plate when fitted can be seen in **photograph 12**. The fifth and smaller screw seen in the picture is that which locates in the groove in the end of the leadscrew and ensures the jaw is withdrawn as the vice is opened. This hole must be left till the final assembly, as its position will be a little uncertain at this stage.

Place the jaw into the base and fit the keep plate, tighten the screws. Hopefully the jaw will be quite tight but still able to move with a firm push; this will minimize the time spent in the final fitting. If this is the case the jaw will not be sufficiently rigid to withstand machining forces. To overcome this, loosen and place a small portion of fine emery paper between keep plate and base on either side and re-tighten.

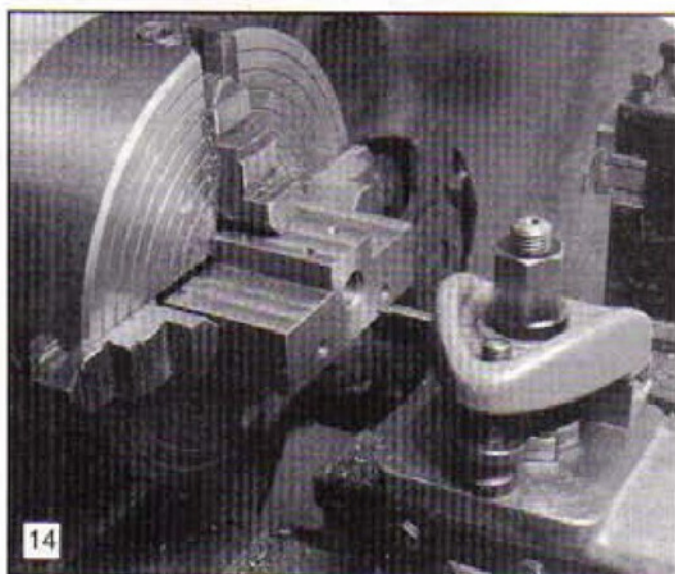
Now place the vice on the machine table ensuring that the front face of the base, already machined, is at right angles to the length of the table. This can be checked, using a dial indicator, or a square off the front face of the table.

At this stage, a number of faces can be machined. First machine the tops of the fixed and moving jaws to the same level. Then machine the inside of the fixed jaw both on its horizontal and vertical faces. Remove no more than is necessary to clean up over the whole of both faces. Take a note of the down feed setting for later use.

Commence to make the recess in the moving jaw for the jaw plate, around 2 to 3mm deep should be sufficient. Take cuts of a height with which your machine is comfortable, and repeat cuts until the down



12 Fitted with the new keep plate.



14 After facing the end of the jaw the hole for the leadscrew is bored.

feed is at the same level as that when machining the fixed jaw, see **photograph 13**. A high degree of precision with regard to depth setting is not required. Finally, at this stage, the sides should be machined so that they are almost level with the painted faces of the sides of the base.

Remove the vice from the table and the jaw from the base. Drill the jaw for two fixing screws for the jaw plate. If possible, make these the same centres, and height, as those in the front jaw; this will make the two jaw plates identical.

Place the jaw in the four jaw chuck and machine the end face and the hole for the leadscrew end, as seen in **photograph 14**. Drill this first with a large drill to produce a hole with a conical bottom, as produced by a standard drill. Do not machine away this cone as it ensures that a hardened steel ball placed in the hole will take up, and maintain, a central position when the vice is tightened. It will be necessary to position the jaw in the four jaw chuck to ensure that the hole produced is at the correct height for the leadscrew, as dictated by the tapped hole in the base at the handle end.

Jaw plates

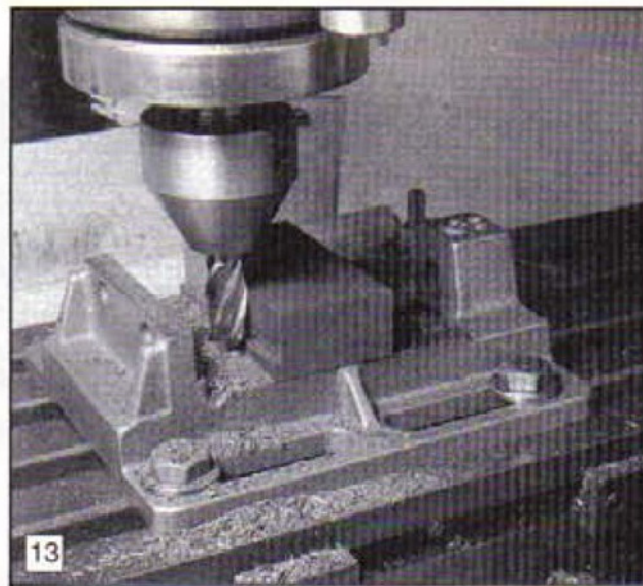
Make the two jaw plates from a piece of BMS, probably around 25 x 5mm, and drill

and tap for the fixing screws. Ensure the strip from which the plates are made is not bent and of equal thickness along the length being used. Fix the plates using suitable screws which inevitably will be too long. Cut off the excess and very carefully file down to be flush with the face of the plate. If you are unhappy about doing this whilst the jaws are in place remove screws and reduce to length in the bench vice. Alternatively, if done in situ and the jaw plates become unacceptably marked, they could be removed and reversed.

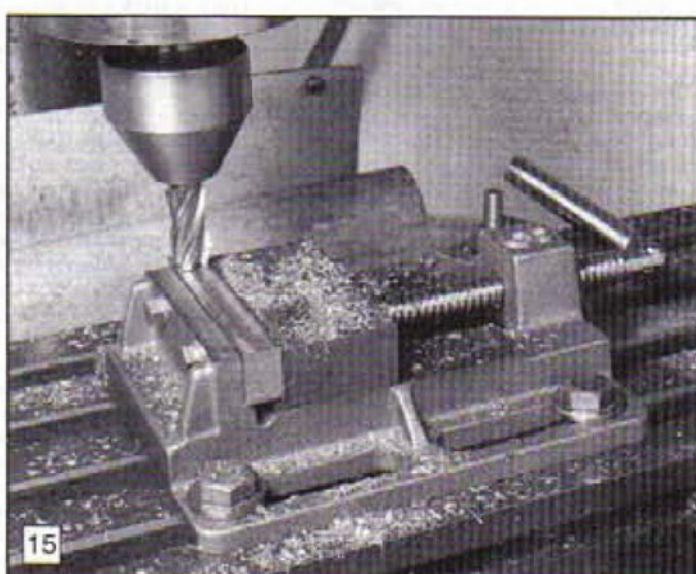
In any event, the jaws should be checked to see that they come together precisely, for if not, they will require machining generally as the set up in **photograph 13**, after returning the vice to the table, using a square or a dial indicator to ensure accurate location. A good method of testing the accuracy of the jaws closing is to place between them a precise strip of metal, such as a hardened and ground parallel, lightly tighten the vice and see if the strip is gripped equally at each end.

Final machining

With the jaw plates fitted and the vice closed quite tightly, and with a hardened steel ball fitted inside the hole for the leadscrew, mark the leadscrew level with



13 Set up for machining the various faces of the fixed and moving jaws.



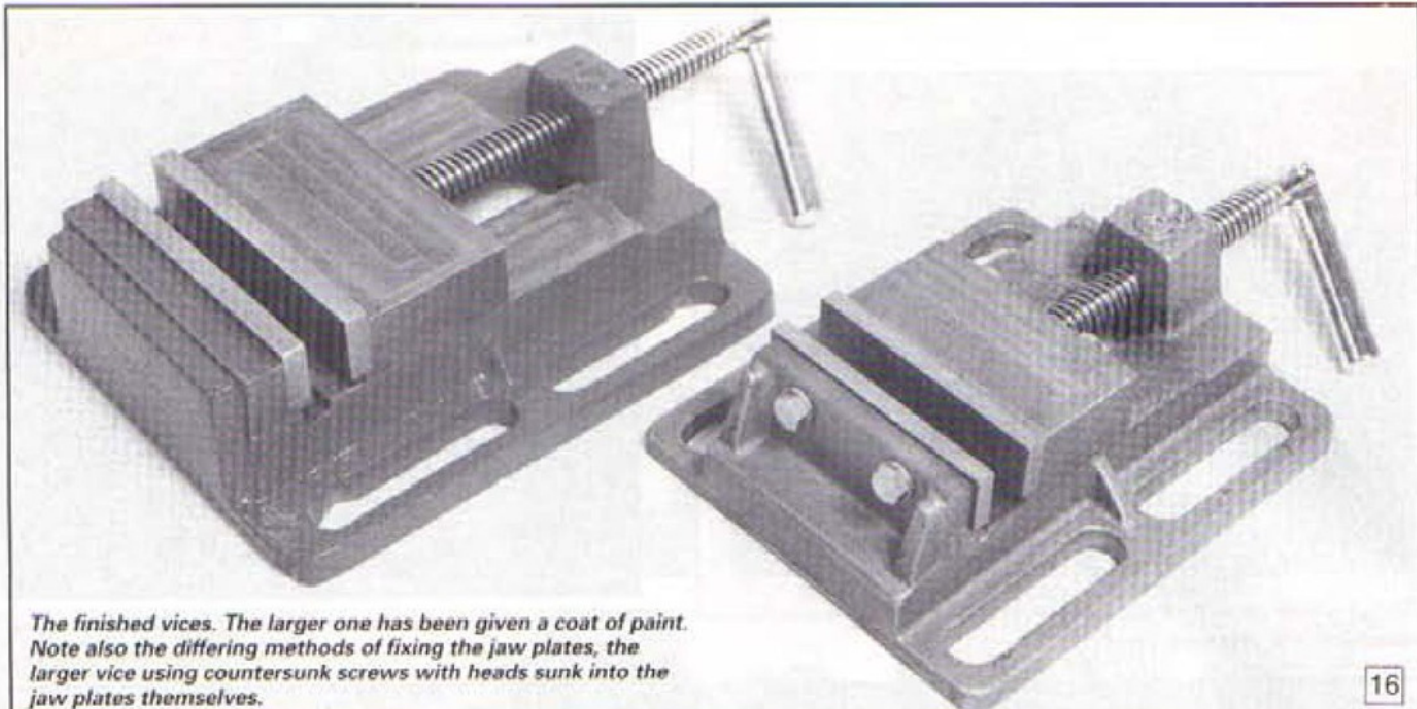
15 Machining the jaw plates, just proud of the fixed and moving jaws, both on top and end surfaces.

the back face of the jaw. Remove the leadscrew partially, sufficient to see the groove for the screw, and from the marking determine where the screw has to be positioned. Drill and fit this screw as required. Now tighten the vice and place on the milling machine. Machine top and ends of jaw plates as illustrated in **photograph 15**.

Final fitting

Remove from the milling machine and very lightly, using a fine file, remove all sharp edges and corners. If the jaw moves along the length of the base freely but without shake, no more has to be done. However, if as suggested earlier the movement is a little on the tight side, take the following action. Remove the leadscrew and the keep plate. Cut a piece of fine wet and dry paper, a little larger than the keep plate making some holes to clear the keep plate fixing screws.

Fit the paper, working side down on the base slide face and replace the keep plate, tightening just sufficient to allow the jaw to slide back and forward. Add a little oil and slide the jaw back a forth a number of times. Remove, clean and refit jaw and check for ease of movement, but without shake, keep doing this until satisfactory working results.



The finished vices. The larger one has been given a coat of paint. Note also the differing methods of fixing the jaw plates, the larger vice using countersunk screws with heads sunk into the jaw plates themselves.

16

This may take longer than anticipated.

If on the other hand the jaw is loose when fitted, it will be necessary to reduce the height of the central tongue of the jaw by rubbing on a sheet of emery paper placed on some suitable flat surface. Again do this until a satisfactory conclusion is reached.

Two sizes of vice

The modification has been carried out to two differing sizes of vice with equally satisfactory results, and these can be seen in **photograph 16**. In case any reader has been confused to this point, it may be worth mentioning that photographs 1 and 2 are of the larger vice, whilst the remainder showing the machining taking place have shown the smaller one.

The vices have proved better than could have been anticipated, and whilst not up to the standard of the genuine milling vice, at about £12 and £15, including cost of cast iron for jaws, are a very economical alternative. Whilst outwardly a little on the fragile side, their low slung construction and large footprint with widely spaced fixings goes a long way towards overcoming this apparent weakness.

If you choose to go along with this idea, it may pay to look at a number of vices

before making your purchase, as quality varies considerably. Close examination of **photograph 2** shows this vice to have very poor slides on which the keep plate runs, stopping well short at each end. The smaller one (from Draper Tools) seen in **photograph 17** is altogether better.

When modifying the larger vice, the inadequacy of the slides was overcome by making some small pads of cast iron, taken from the scrap from the jaws, and fixing these in place with some resin adhesive. The base was locally machined to give a flat face for the fixing of the pad. The pad was then finish machined at the same time as machining the slide so as to give a continuous sliding surface. This approach is illustrated in **photograph 18**. As, in the worst case, the jaw lifts at the front and lowers at the rear, no pads were fitted at the handle end, which in any case was not so bad. The vice would not get much use at this width anyway.

Fixing to the table

The long fixing slots give the impression of being easy to fit to the machine table. This would be so if fitted across the table, but this is not that likely, being fitted along the table is much more probable. In this

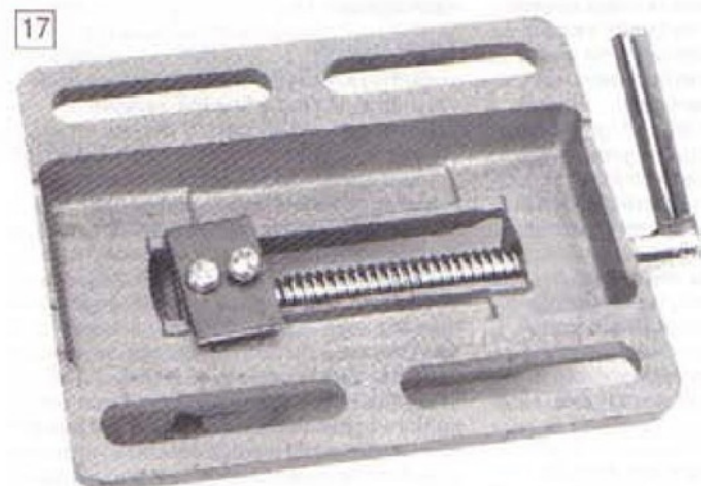
mode fitting is easy only if the slots in the vice line up with those in the table, in my case they do not.

The outer webs of the slots could be removed as these add very little to the strength of the vice, this would leave the flanges along each side on which clamps could bear down. I was reluctant to take this way out and deface the vices further. The difference between vice slot pitch and table slot pitch was not great and a method to overcome this small difference soon became obvious. As the method probably has benefits in other applications I have written this up as a mini article which is being published elsewhere in this issue.

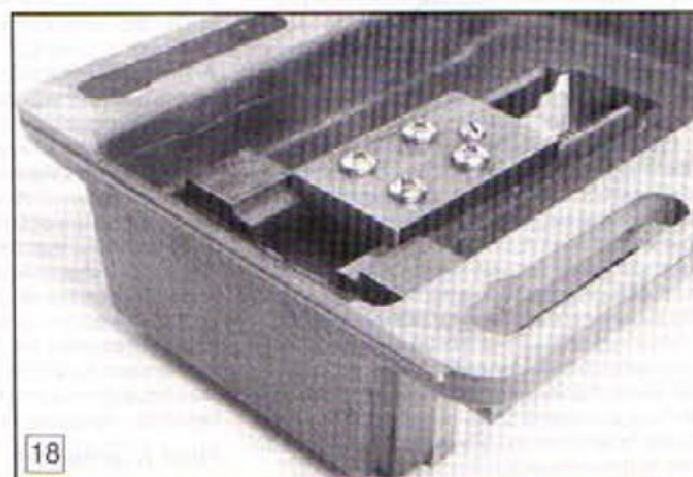
Supplier details

Vices. The type of vice illustrated in this article are available from practically all suppliers of tools and machines to the home workshop. Draper Tools, mentioned in the text, are at Draper Tools Ltd, Hursley Road, Chandler's Ford, Eastleigh, Hampshire, SO5 5YF. Tel. 0703 266355. Fax. 0703 260784.

Cast iron block. The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton, WV8 1EJ. Tel./Fax. 0902 842284.



Compare the rather better sliding surfaces (continuous to the ends) of the smaller vice, with those in photograph 2 of the larger vice.



Overcoming the inadequacy of the slides on the larger vice by the addition of pads which are machined at the same time as the slideway to give a continuous surface.

DRILL/MILL DOWN FEED STOP

Another simple modification to an earlier far eastern mill/drill, this one to overcome the unwelcome flexibility of the down feed stop.

Many readers have commented on the very good value for money which the early mill/drills represented, and that there were minor weaknesses present with many of those supplied. One such weakness with the machine that I purchased around 1978 was the lack of rigidity of the down feed stop.

This gave a rather imprecise result which made its use only adequate for parts requiring a low level of precision. The problem lay in the fixing of the casting which carried the adjusting stud.

The machine was fitted with an extension spring to lift the spindle, so as to overcome the backlash present in the down feed mechanism. This subject has been responsible for much correspondence in both *M.E.W.*, and *M.E.* on numerous occasions. It appears to be a fault with almost all economy machines of this type (I inspected most, if not all, such machines at the 1992 exhibition and found they all had no means on overcoming this problem. - Ed.).

The use of a simple extension spring does overcome the problem quite well. It does have the disadvantage that drilling can become very insensitive, especially when the quill becomes almost fully extended. However, that is not the subject of this article.



The view shows one existing screw; the left hand one, and the added screw being on the right of the picture. A similar pair of screws are on the other side of the casting.

The casting that takes the upward force of the spring can be seen in the drawing of the original arrangement, also the photograph. The spring is anchored to the extension at the rear of the casting, and the downfeed stop stud to the front extension.

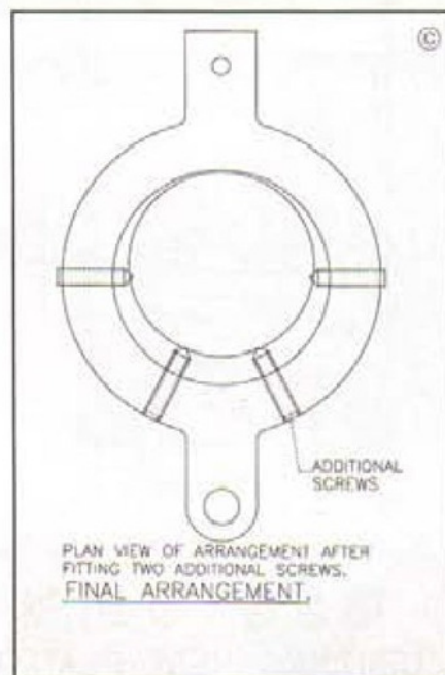
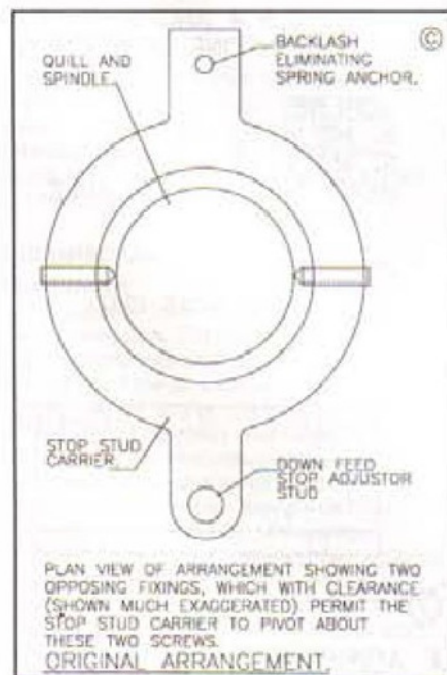
It can be seen from the drawing of the original arrangement that the fixing of the

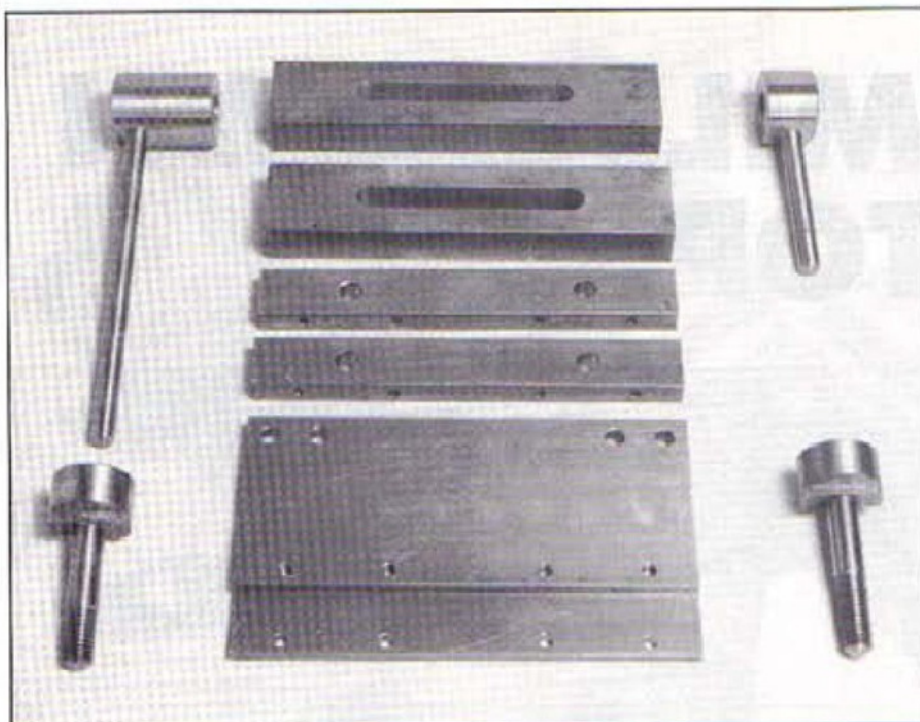
casting is by two diametrically opposing screws. A ludicrous arrangement in itself, but one which is totally inappropriate for this application. As a result of this arrangement the casting pivots on these screws and with the upward pull of the spring lifts the rear of the casting and lowers the front end.

When the downward movement of the quill causes the stop nut to hit the stop face, the first sensation of the quill being stopped is felt. But due to the pivoted casting the quill can continue to lower, pivoting the casting, see saw fashion, further extending spring until the pivoting action limit is reached. This results in a very spongy feel to the stop action, which is totally inadequate for its purpose.

Overcoming the problem is very simple as can be seen in the drawing showing the arrangement after the modification. This consists of adding two screws which act to pull the casting forward and thereby eliminate the rocking action. The existing screws were also left in position and tightened, whether these add anything to the final rigidity of the assembly is difficult to be sure, but at least no harm is done by their remaining.

Ideally the casting should be removed so as to drill and tap for the additional screws using a drilling machine. This would be a major dismantling job and I felt it was not worth the effort. The holes can be drilled using a hand drill, taking care not to drill into the quill itself other than a small indent. Tap the hole with flat ended tap to get the thread to the bottom of the hole and fit the required grub screw. This modification should take no more than 30 minutes to complete and will be a very worthwhile improvement to machines having this problem.





The finished parts prior to assembly. Note that the six parts made from strip have been made the same length to ease manufacture.

A PLATFORM FOR THE HART

The method adopted for raising and positioning the Hart Grinding Rest in the article published in the last issue, was a block of wood and a G clamp, not a very professional method. Here we propose a much improved approach to the problem

The method for raising the Hart grinding rest to the height required, shown at the end of the last article, was simply to place this on a suitable thickness block of wood. This was very much a temporary measure to enable the initial tests on the grinding rest to be carried out quickly. A more engineered approach to this problem has now been taken, and is the subject of this article. The benefit of the device is two fold; initially the main requirement was to raise the level of the grinding rest to suit the fin. grinder with which it is used. Whether this is a requirement for other users will depend on individual circumstances. If not, the platform may still be considered worth making for the second benefit alone; the ability to adjust the position of the rest in the left and right directions. The slotted arm on the right hand side of the grinding rest will permit it to be raised for smaller grinders, as the table can be mounted lower on the arm.

Having already conceived the germs of other ideas for adapting the grinding rest

for additional activities, such as grinding along the edges of an end mill, I feel the left and right adjustment will eventually be of great benefit.

The design

It has been intimated, if not actually said, in *M.E.W.* on a number of occasions, that productivity, as it is understood in industry, is not a priority in the home workshop.

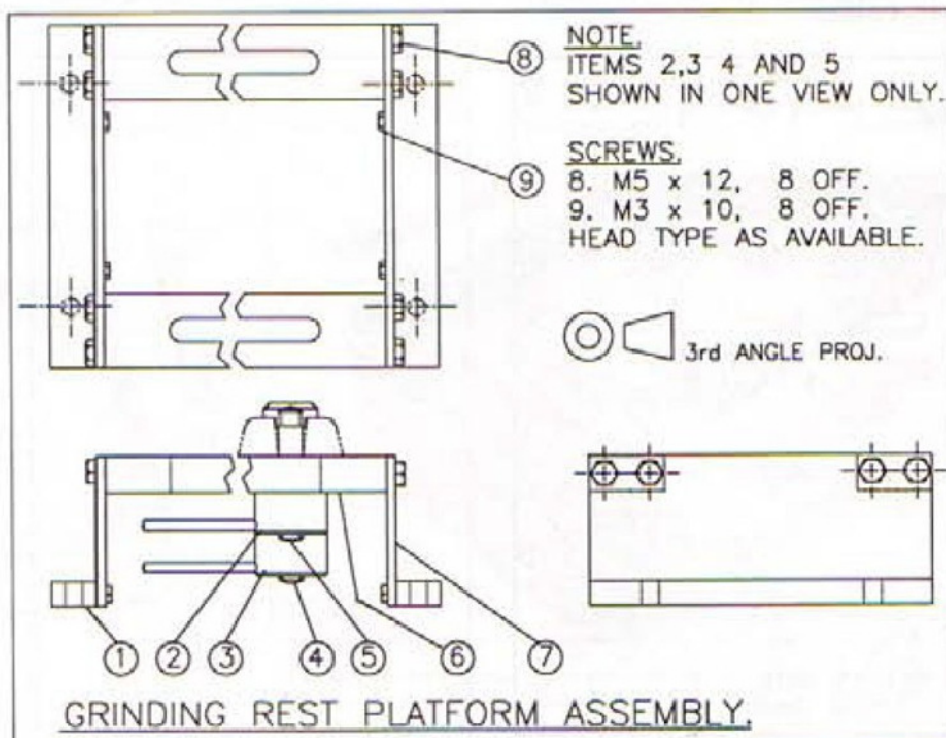
While this may be largely true, there is no reason why efficient use of time, machines and materials, should not be given due consideration. Productivity is not just a case of the chosen method of manufacture, any good designer of equipment will give much thought to the actual production involved in the design being undertaken; understanding that careful design can benefit productivity just as much as the chosen method of manufacture. With less scope in the home workshop for alternative methods of producing a given item, its actual design can be of even greater importance. The design for this grinding rest platform was undertaken with this in mind.

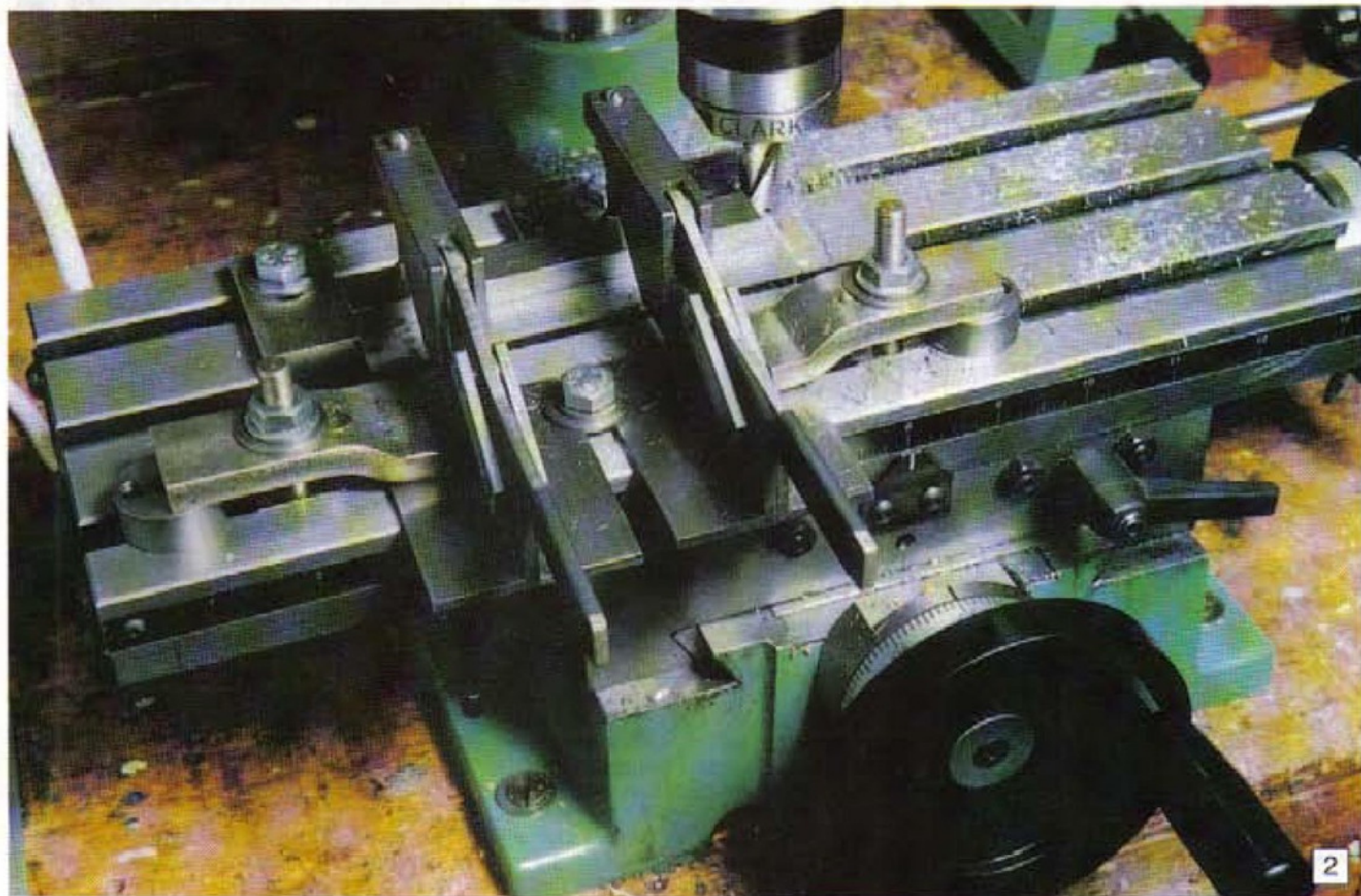
The initial idea was to make a platform from 125 x 10mm BMS and raise this using 50 x 50 x 6mm BMS angle for the ends. This would necessitate the purchase of the materials as neither were available. The 50mm wide feet would also be excessive, and the angle would therefore have to be cut down, say to 50 x 20 x 6mm. This approach did not appeal due to having to purchase the materials, secondly it would be unduly heavy, and as a result, expensive.

After further thought, it was decided to make the top from two strips, and the angles from two pieces, this can be seen in the assembly drawing and the photographs. Having established the design thus far, the idea of making all six parts in the main assembly the same length came to mind. The result can be seen in **photograph 1** which shows the finished parts. This would enable the stop on the cut off saw to be set when cutting parts from bar material, making it an easier operation.

Similarly, when machining the ends on the milling machine, the use of a back fence and end stop would avoid repeated measurement of each part. In all, coupled with the use of the toggle clamps seen in **photographs 2 and 3**, a rapid and less prone to error method of machining.

Finally, the method of fixing the grinding rest onto the table required consideration. This could be just normal screws with nuts and washers, but this would necessitate the

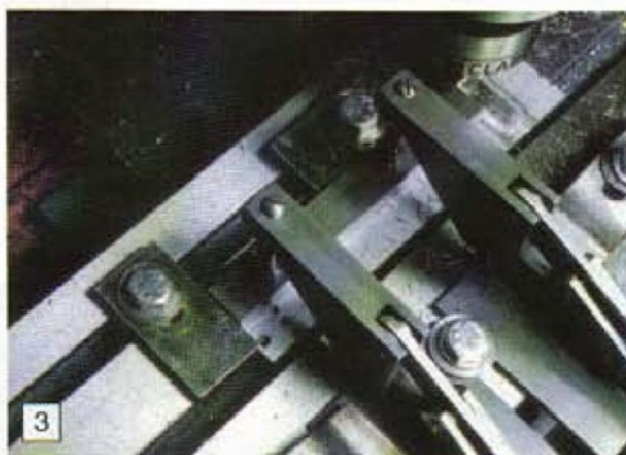




2: Machining the ends of the six strips. The use of a rear fence, end stop and the toggle clamps makes this a rapid operation.

3: A close up view showing the fence and end stop.

4: The assembly with rest mounted.



permits the mill/drill to be set up as in **photograph 5**, with a small centre drill and the coordinates set for the position of the first hole. The fence clamped to the rear of the angle plate permits the bar to be rotated back to front and the second hole position established. The bar can then be turned end on end and the same process undertaken. With this method adopted, the eight holes can be centred and then drilled in a very short time.

Now mark out, drill and tap, parts as per drawings, where possible mark only one part; then stack up two parts and drill together. First drill the side pieces (7), then use these to position holes A in the foot (1).

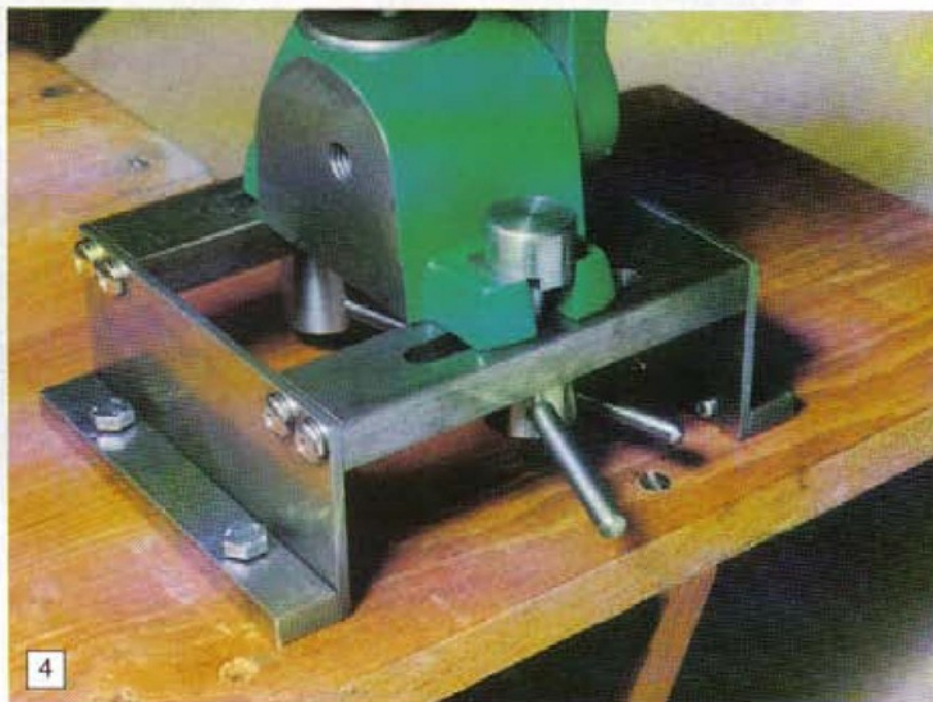
Machine slots in slotted bar (6) as seen

use of spanners and was considered a non starter. As a result, the approach taken is as seen in the assembly drawing and **photograph 4**, both fixings therefore being able to be tightened with ease from the operator side.

Manufacture

Main frame

This is easy to make, and needs very little description. Cut the six pieces to the same length and clean up the ends, using milling machine or vertical slide, fix side and end stops on the machine table so that each part can be easily machined to the same length, as discussed above. Make sure that you place a piece of scrap material under the part being machined, to eliminate any possibility of the cutter fouling the machine table. Another instance of a little thought given to the design helping manufacture, is the fact that the holes in the end of the slotted bar (6) are central in the 12mm width and equal distances (5mm) from each edge. This



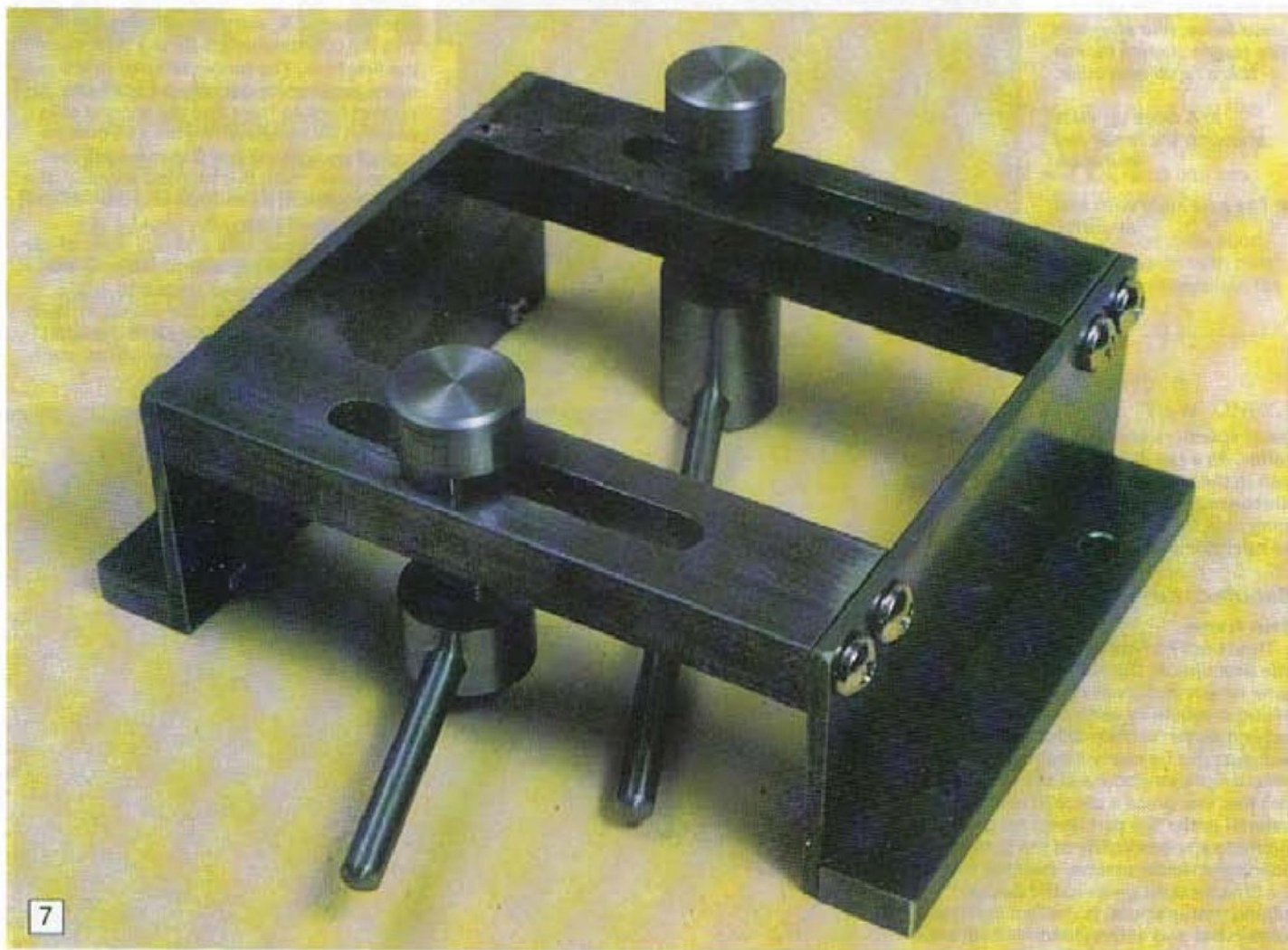
5: Set-up for marking out position and drilling of ends of bars.

6: Machining the slot in the top bar.

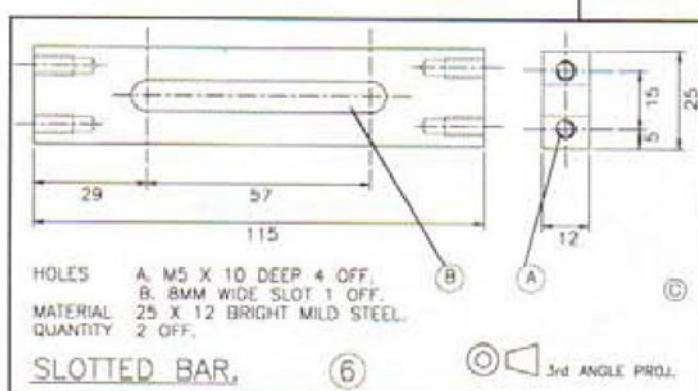
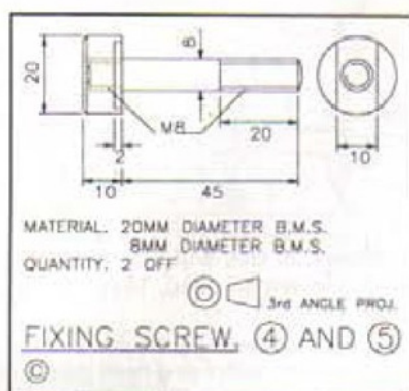
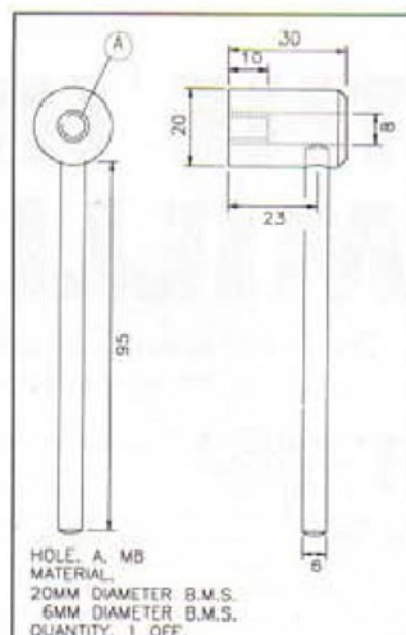
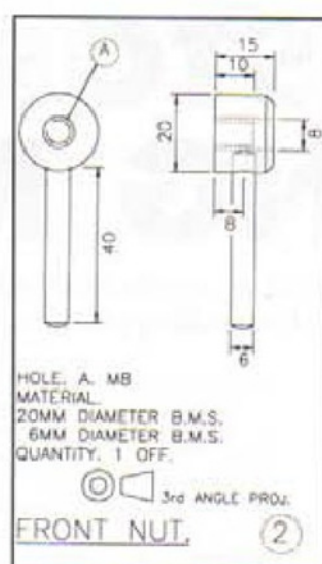
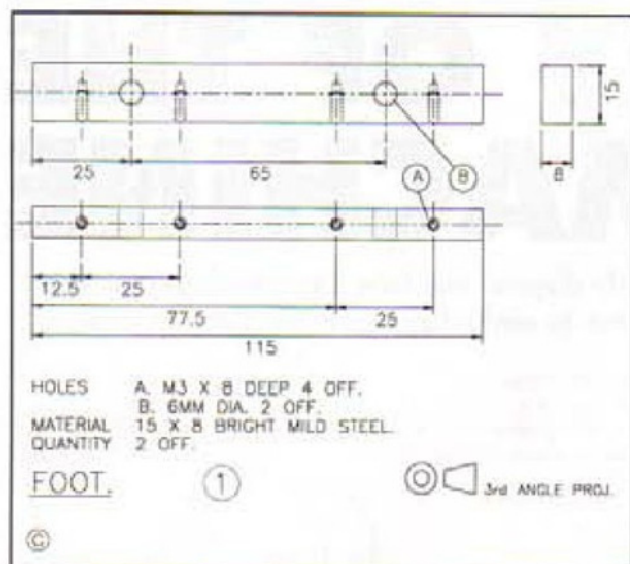


in **photograph 6**. Do not be tempted to stand one on the other and machine both at the same time. Keeping an enclosed slot such as this free of swarf is not that easy, and will be considerably more difficult if the depth is increased by attempting to machine the two at one setting. Once again, set up a rear fence and stop so that the second bar can be machined without recourse to measurement. If your machine has table travel stops, set these for the length of the slot. Don't forget that piece of scrap below the part to protect the table.

Some readers will, I am sure, consider that an assembly such as this should be fixed together using cap head screws. If such types are available, by all means use them, or if you feel strongly about this, purchase some. Next preference will be hexagon headed, but as can be seen in the photograph pan head screws have been used for the prototype. When assembling, fix the grinding rest base onto the slotted bars and rest the complete assembly onto a surface plate, or other reasonably flat surface, prior to tightening the screws. This



7: The finished assembly.



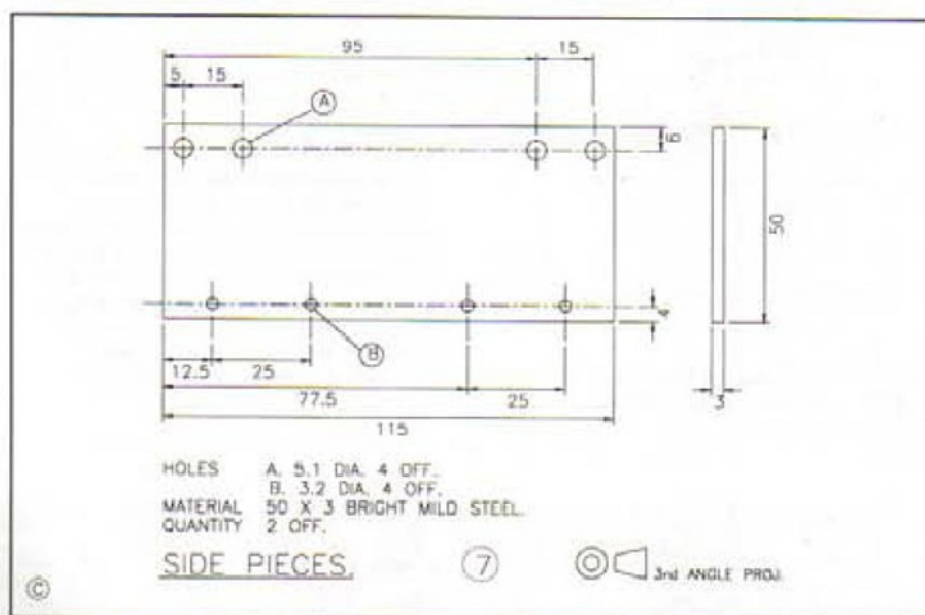
method will ensure the parts are adequately aligned. With the platform assembled, remove the grinding rest base, debur all edges and corners.

Fixings

The fixing screws (4 and 5) are shown on the drawings as being made from two pieces to save on machining, whether this is quicker I am not sure. If you prefer they can be turned from the solid. Both parts are shown as identical, in use however, the minor differences in the thread position will necessitate them being paired with its own nut, front (2) or rear (3). For this reason it will be an advantage if the position of each one can be easily determined, I would suggest that the rear screw be made a few millimeters longer.

The nuts (2 and 3) are made to two lengths, this enable the arm of the rear nut to swing past the front one. A full threaded nut confers only minor benefit in terms of thread strength, so they are counterbored to give a length of thread of 10mm, more than adequate. This will speed up their completion and also provide a guide for the entry of the tap to ensure the thread is true.

The 6mm diameter arm has to be fitted in the correct position so as to ensure that it rests in the most suitable position when the nut is tightened. To achieve this, fix the base of the Hart grinding rest using the screws and nuts and tighten firmly. Mark the front nut so that the arm when fitted will point forward and in the case of the rear nut, slightly to the right. Remove and drill, then fit the two arms by what ever method you prefer, adhesive, silver solder etc.



Final assembly

Fitting and removing the rest from the platform is easy, but must be done in the correct manner. The arm of the front nut is just short enough to enable the nut to rotate fully, so with the base roughly central, undo the front nut totally and remove nut and screw. With this done, the rear nut can be loosened and the base withdrawn forward, enabling the screw to be rotated and therefore fully withdrawn.

Not only must the screws be in their correct position, that is front or rear, but must also be orientated correctly in one of the two positions permitted by the tee

shaped head. A suggested method would be to mark the head of the screw with a centre punch mark adjacent to the Hart grinding rest base, by this method the screws can easily be returned to the correct position each time they are fitted.

Conclusions

In use the ability to move the rest left and right, therefore being able to achieve the best position for its use, has been found to be a distinct advantage. It is therefore considered a worthwhile addition, whether or not the requirement to raise the rest is a necessity.

THE HISTORY OF THE MILLING MACHINE

Don Unwin provides us with another insight into the early days of machine tool development, this time describing the history of the milling machine, from its early days up to the present day.

The first generation of machine tools – the lathe, planer, slotter, shaper and boring machine – used a single point tool which could be easily made by the blacksmith and sharpened offhand on the natural grind stones of the period.

Although mostly using flycutters for gear cutting, some early workers had attempted to use rotary cutters having very fine teeth; these were really only rotary files. Diderot in 1772 shows a musket barrel finishing machine which used a multiple tooth formed cutter, whilst the earliest known existing example of such a cutter is that made by Jaques de Vaucanson c1780. It is also believed that Bodmer used rotary cutters while he was working at St Blaise in 1806. These cutters, like the clock tooth cutters, had no form relief and when blunt had to be softened, reshaped by file and rehardened.

Shortly after James Nasmyth started with Henry Maudslay he was given the job

of assisting with making a model of a large 200 HP marine steam engine, at that time under construction in the factory. Maudslay insisted that the model should be in exact conformity with the original, and this included about 300 hexagon bolts and nuts, some with collars. In order to machine the six flats on each, Nasmyth, in 1829, devised and made the milling machine shown in **Fig.1**. It was very successful, and about a year later, Maudslay made a similar but larger machine for use in his factory. It was on this machine that coolant, probably water, was first used on the cutter, supplied from a drip can. When in business on his own, in the 1830s, Nasmyth made and sold many of the machines (as shown in **Fig.2**) to other manufacturers. As with all these early cutters the teeth were filed and fairly closely spaced.

In the U.S.A. one of the first milling machines was that made in 1818 by an English emigrant gun maker, Robert Johnson; this was similar in design to Nasmyth's.

However the first surviving true ancestor of the modern milling machine was that devised by Eli Whitney in 1820 for making small arms components.

Lathe adaptations

As all these machines were lathe adaptations they had no outer arbor support and no vertical adjustment, the cut being set by packing the work up. Bay and Silver were probably the first to make a machine with vertical adjustment (**Fig.3**) in 1847, this machine still being at work in 1908! Note the jockey pulley on an adjustable arm to enable the belt to be

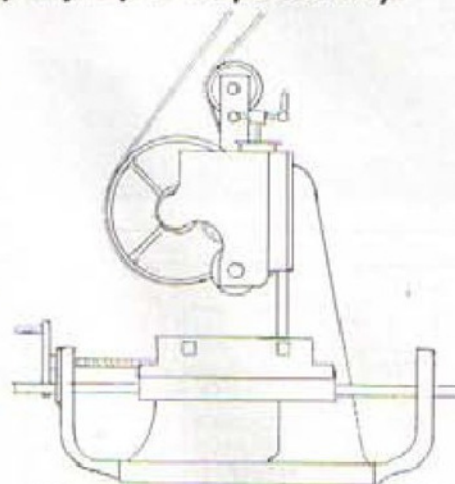


Fig.3: Sketch of Gay and Silver miller with adjustment on head, 1841.

retensioned after moving the cutter arbor, always a problem with rising head millers. Because the American designers had derived these early milling machines from the lathe, they made life difficult for themselves for many years by arranging the vertical adjustment on the arbor instead of the workholding slides. Robbins and Lawrence entered the field in 1848 with Frederick Howe, one of the outstanding American machine designers of the time, working with Lawrence designing a much heavier machine. This was followed by the "Index" machine, which is illustrated in **Fig.4**. This was built by Howe and Lawrence, and made for sale in 1850. This machine supported the work on an indexable vertical column which also had vertical adjustment, however the arbor still

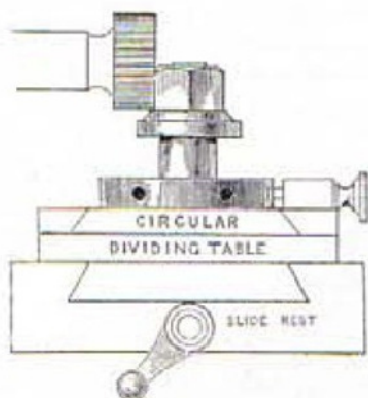


Fig.1: James Nasmyth's hexagon nut milling machine, 1829. (James Nasmyth Engineer, an autobiography, 1883).

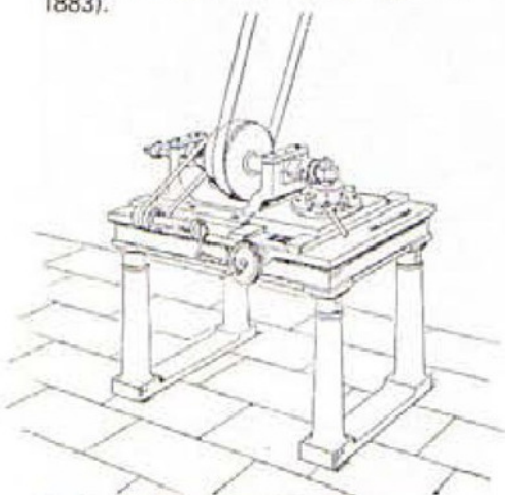


Fig.2: James Nasmyth's hexagon milling machine made for sale, 1836. (As Fig.1).

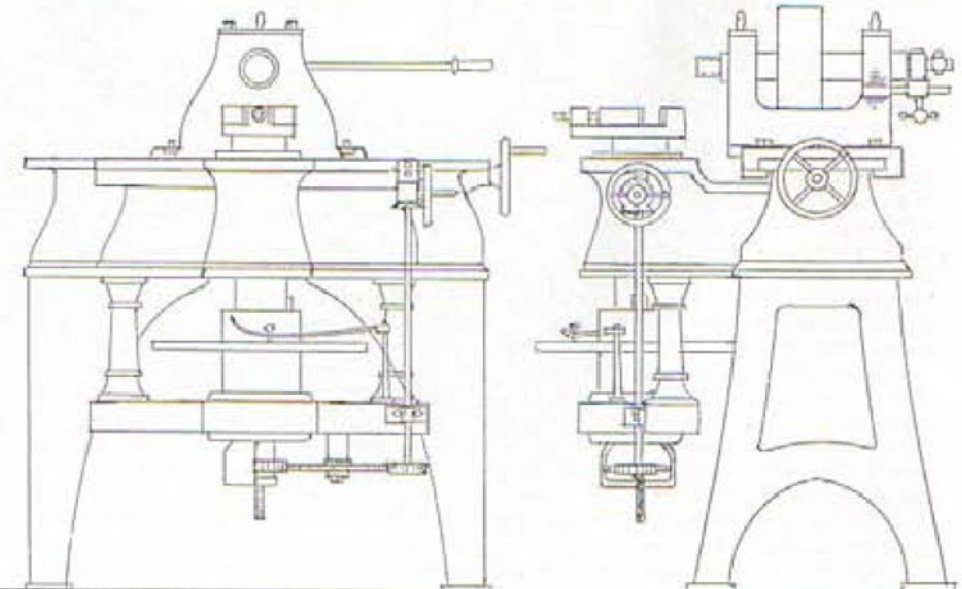


Fig.4: Sketch of the Lincoln "Index" miller, 1850.

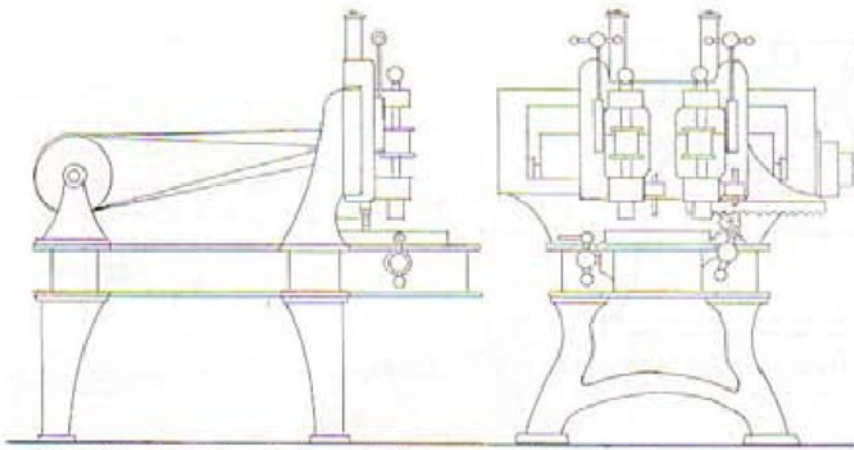


Fig.5: Sketch of Howe's two spindle profile milling machine, 1848.

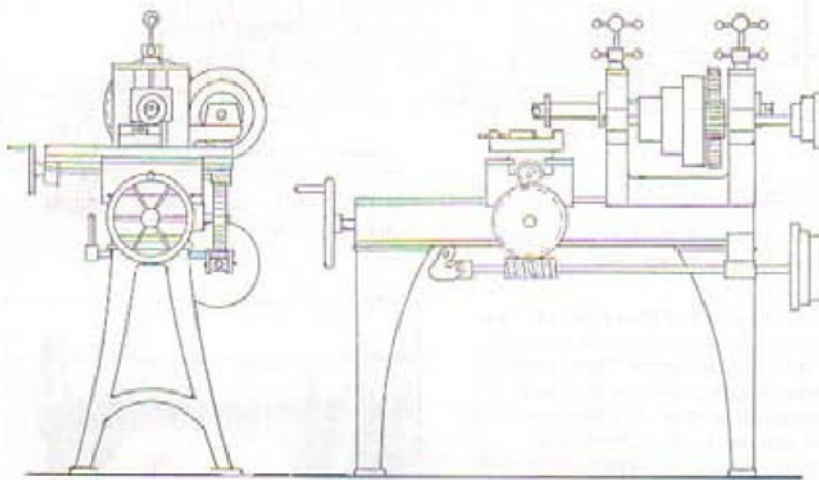


Fig.6: Sketch of the "Lincoln" miller, 1852.

had no outer support.

Another of Howe's designs whilst he was with Robbins and Lawrence was the two spindle profile milling machine in which two components could be machined simultaneously. The cutters were guided by a tracer pin going round a former; making it a particularly valuable machine for the small arms industry. Machines of the same basic design were being made well into the 20th century, see Fig.5.

The last machine Howe designed for Robbins and Lawrence before they failed was in 1852, a machine with an over arm

arbor support and a knee type slide for vertical adjustment. Many of these machines were sold to the U.K. to equip the new government owned Royal Small Arms factory at Enfield, North London.

When the new Colt Armory was being equipped in 1853/4, George S. Lincoln & Company supplied a large number of milling machines made to the design of F.A. Pratt, developed from the Howe machine of 1852 (Fig.6). It became known as the Lincoln miller and the design changed little right up to the mid 20th century, by which time over 150,000 are

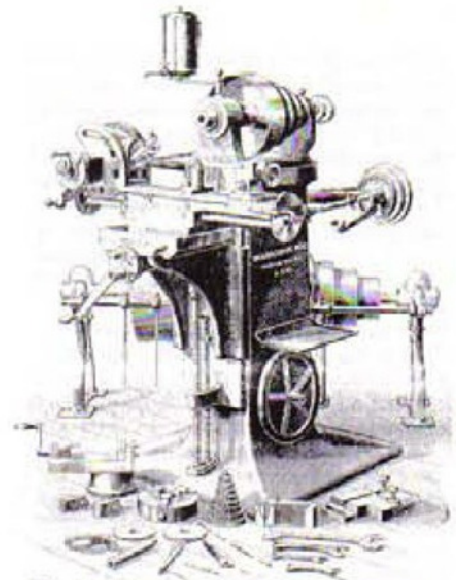


Fig.7a: Brown and Sharpe Universal miller, 1879. (Brown and Sharpe catalogue).

believed to have been made in the U.S.A. and Europe.

From 1860 onwards there were many advances, probably the advent of the Brown and Sharpe Universal miller was the most significant, a machine developed for a specific purpose, ultimately to be the most widely used form of milling machine.

In New England the twist drill had been evolved for the small arms industry. The Providence Tool Company supplied many of these drills; the flutes being filed by hand! Frederick Howe who had joined Providence after the R & L failure realised that this operation must be mechanized and in 1861 asked Joseph Brown of the Brown & Sharpe company for help. Although this latter company had started in business in 1833, they did not enter the machine tool business until 1860, with the introduction of their first turret lathe. Brown wasted little time and in March 1862 the first knee and column type machine incorporating his innovations for milling spiral grooves was delivered to Providence Tool Company, with nine more being made before the end of the year. Before long, back gear and overarm arbor supports were being fitted, Fig.7a. The contemporary knee type horizontal milling machines at the time had the longitudinal table fixed

Fig.7b: The author's Arno miller set up for milling a twist drill.

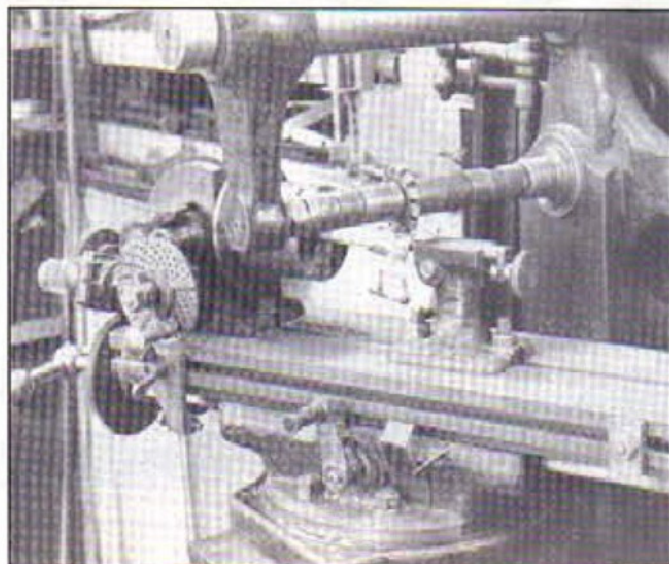
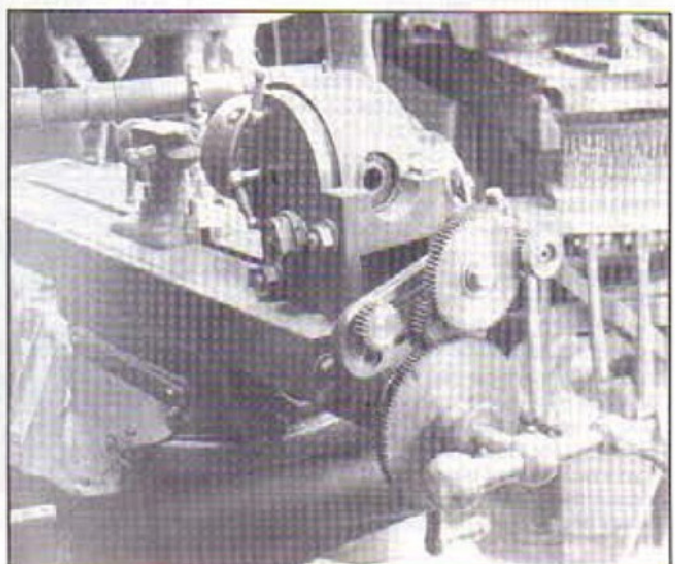


Fig.7c: The change wheels between the dividing head and lead screw.



rigidly at right angles to the arbor and cross slide. Joseph Brown's invention was to provide means whereby the table could be adjusted from the right angle position to the arbor to one equal to the helix angle of the required spiral. In addition he modified the dividing head so that the index plate was coupled to the traverse lead screw by change wheels; as the table was traversed along by the lead screw the head rotated to give the lead required for the spiral. To illustrate this feature, **Fig.7b** shows my Arno miller set up to mill twist drill flutes; **Fig.7c** shows the train of change wheels connecting the dividing head index plate to the lead screw.

Although originally designed for milling the spiral grooves in twist drills, it quickly became apparent to machinists that it could be used to perform many other tasks and Brown and Sharpe's resources were soon strained to meet the demand for machines.

The Howe adjustable head machine popularized by the Lincoln Company

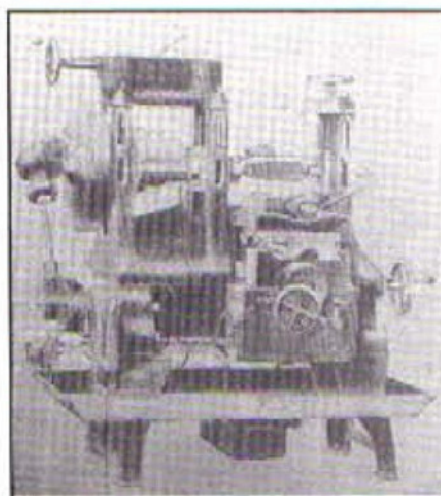


Fig.8: Putnam semi-automatic Lincoln type miller, c1917.

continued to be made in large numbers for plain milling operations and became known as the Manufacturing Miller, **Fig.8**.

Apart from vertical adjustment by the knee and column other ways of achieving it on the spindle were still being devised. For example in 1885, Hutton made a rocking head machine, **Fig.9** and Brown and Sharpe a similar idea, but with a swinging head, **Fig.10**.

An early universal mill

Another development in 1874 was that of P. Hure who made a machine with both vertical and horizontal spindles mounted on the column, which could be rotated to swing the desired head into the working position, the ancestor of the modern Bridgeport dual head machines, **Fig.11**. In 1890 Brown & Sharpe brought out a vertical milling machine, although they had made a vertical milling attachment for fitting to the Universal mill many years earlier, **Fig.12**.

In the U.S.A., where the demand was for quantity production of small components the milling machine had gained in popularity over the planer and shaper, although in the U.K. adoption was much slower, as the need was for larger machines to work on fewer numbers of bigger components for locomotives, steam engines and similar heavy engineering products.

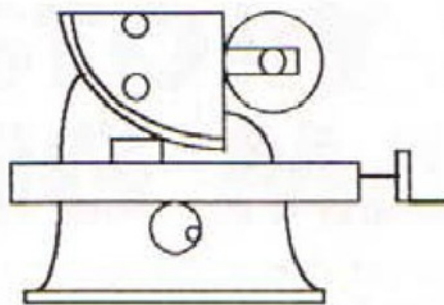


Fig.9: Hutton rocking head milling machine, 1885.

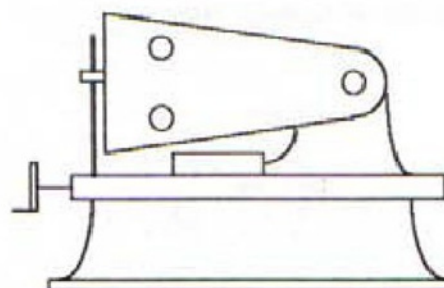


Fig.10: Brown and Sharpe swinging head milling machine, 1895.

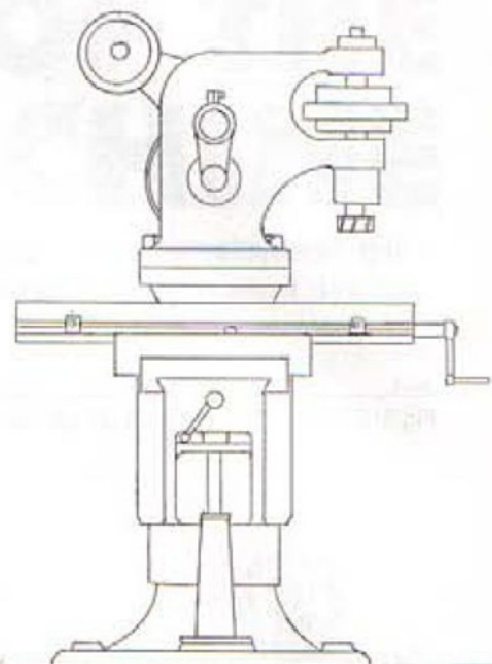


Fig.11: P. Hure two spindle milling machine, 1874.

The development of the miller had been influenced by the improvement in cutter design, for instance by the 1860s it was found that performance was improved if fewer teeth and greater chip clearance was adopted. Inserted tooth cutters were particularly valuable for large cutters as the high cost tool steel was only needed for the cutting teeth, the body being of a less expensive material.

The milling machine was sometimes married with other machines, for example in 1892 the plano-miller appeared, a planing machine, usually large, with milling heads on the standards and cross beam, **Fig.13**. The borer miller was another, a vertical boring machine with an additional milling spindle on one side of the columns. Yet another marriage which first appeared in 1897 was the thread mill in which

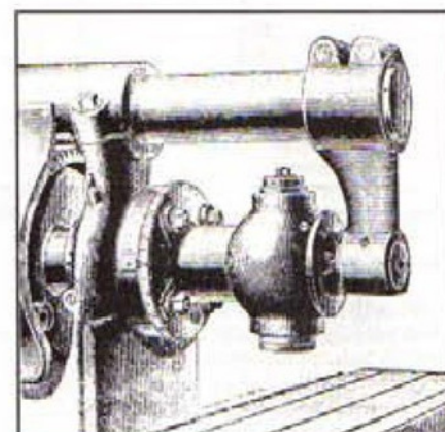


Fig.12: Brown and Sharpe vertical head attachment, 1879.

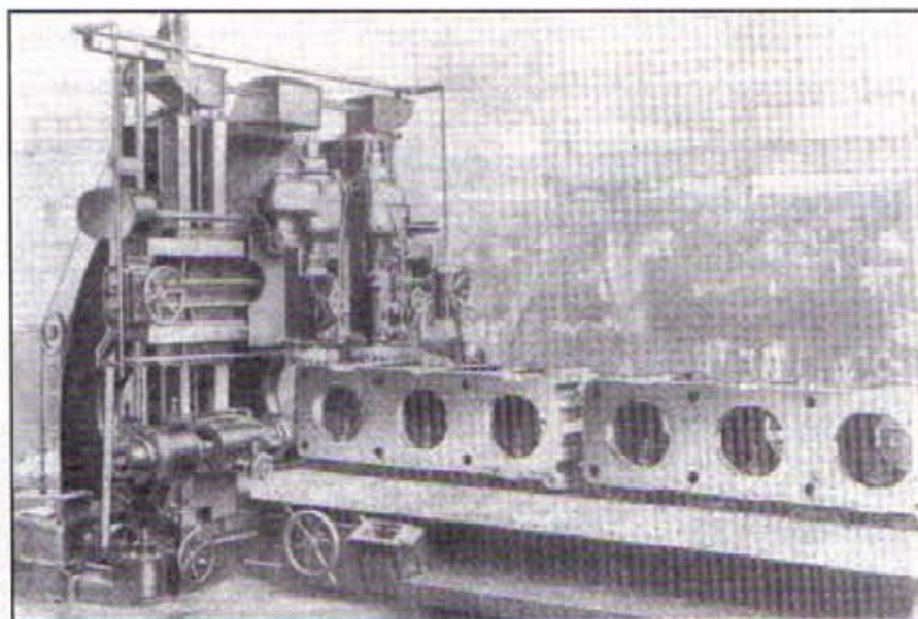
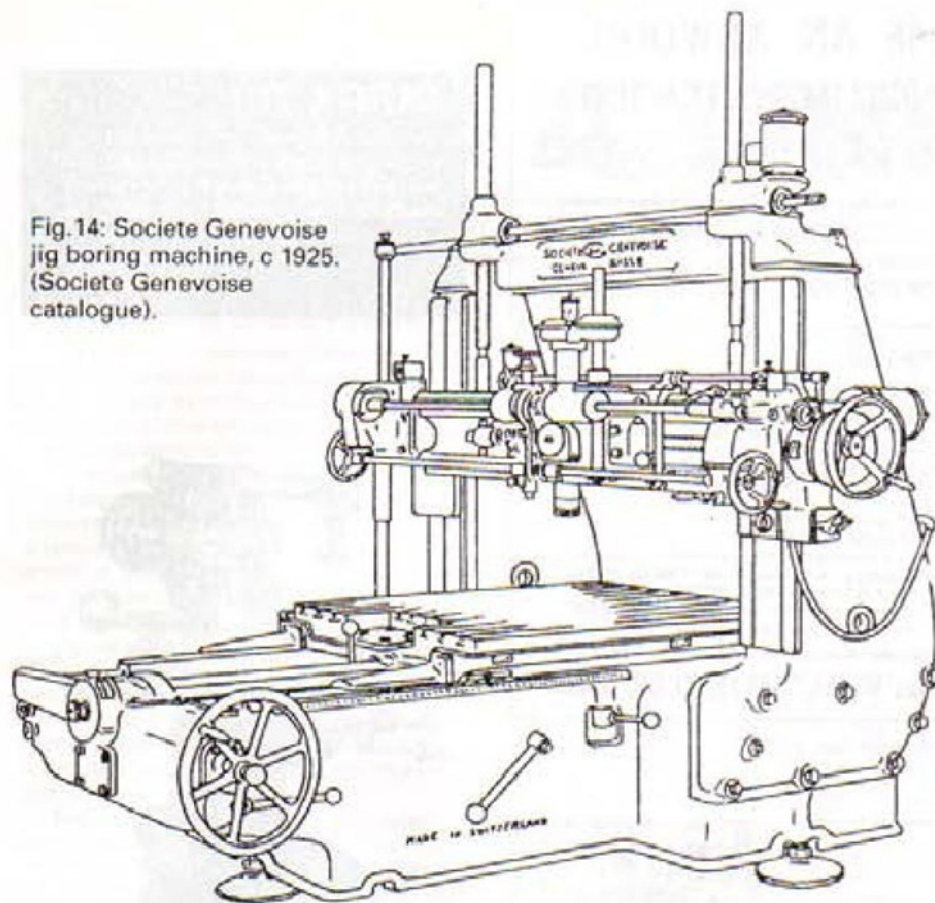


Fig.13: Kendall & Gent Plano-miller, c1934. (Railway Gazette).

Fig.14: Societe Genevoise jig boring machine, c 1925. (Societe Genevoise catalogue).



threads and worms are cut by a rotating form cutter in place of a single point tool on an adaptation of the screw cutting lathe. Possibly the ultimate is the jig-borer in which a high quality vertical miller is fitted with precision measuring scales, Fig.14 or even numerically controlled, then later controlled by computer as in the modern machining centre, Fig.15.

By 1910 the miller had developed from Brown's relatively small Universal to a range covering quite large and sophisticated machines, Fig.16 and was second only to the lathe in importance with vertical machines becoming much more popular, Fig.17.

Early days of milling in the home workshop

The initial high cost of the machines and the cutters discouraged their use by the amateur machinist. However, vertical slides to make adjustment of work being milled in the lathe and auxiliary milling spindles which could be mounted on the lathe saddle, Figs. 18 and 19, usually driven from an overhead countershaft, Fig.20 began to appear at the end of the 19th century. These have continued to be made until the present day, although somewhat displaced by the many millers now available for the amateur market.

At the time the only machines available for the amateur were small industrial types. My little German copy of the Brown and Sharpe Universal of 1912 vintage, Fig.21 is an example. Small millers, mostly horizontal types, specifically for the

Fig.15: S.I.P. Automatic co-ordinate jig boring machine, 1950. Ibid.

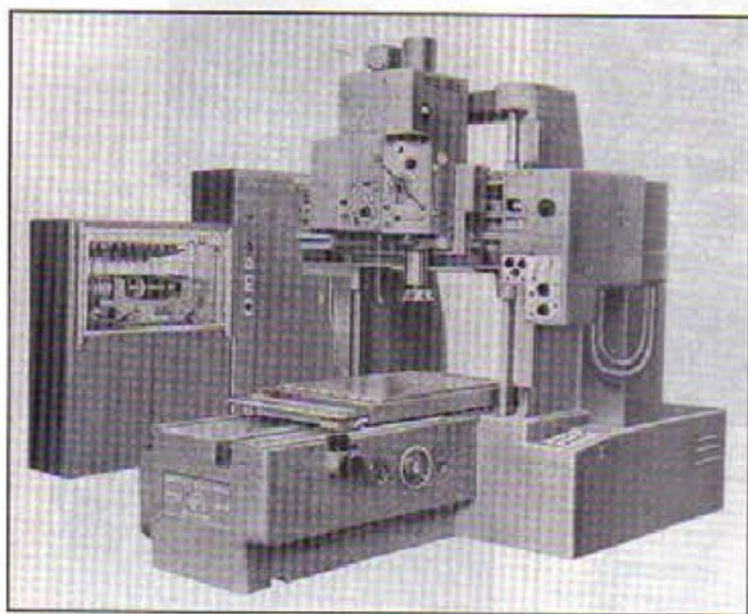


Fig.17: Kendall and Gent vertical miller. (The Engineer, 1896).

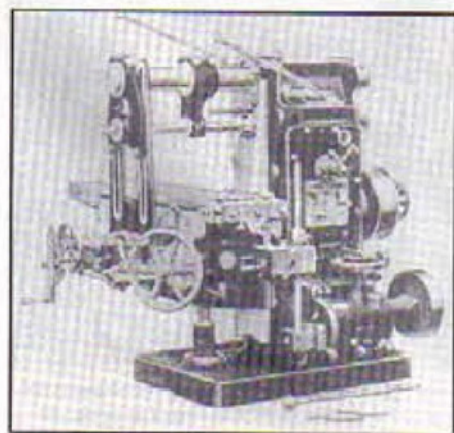
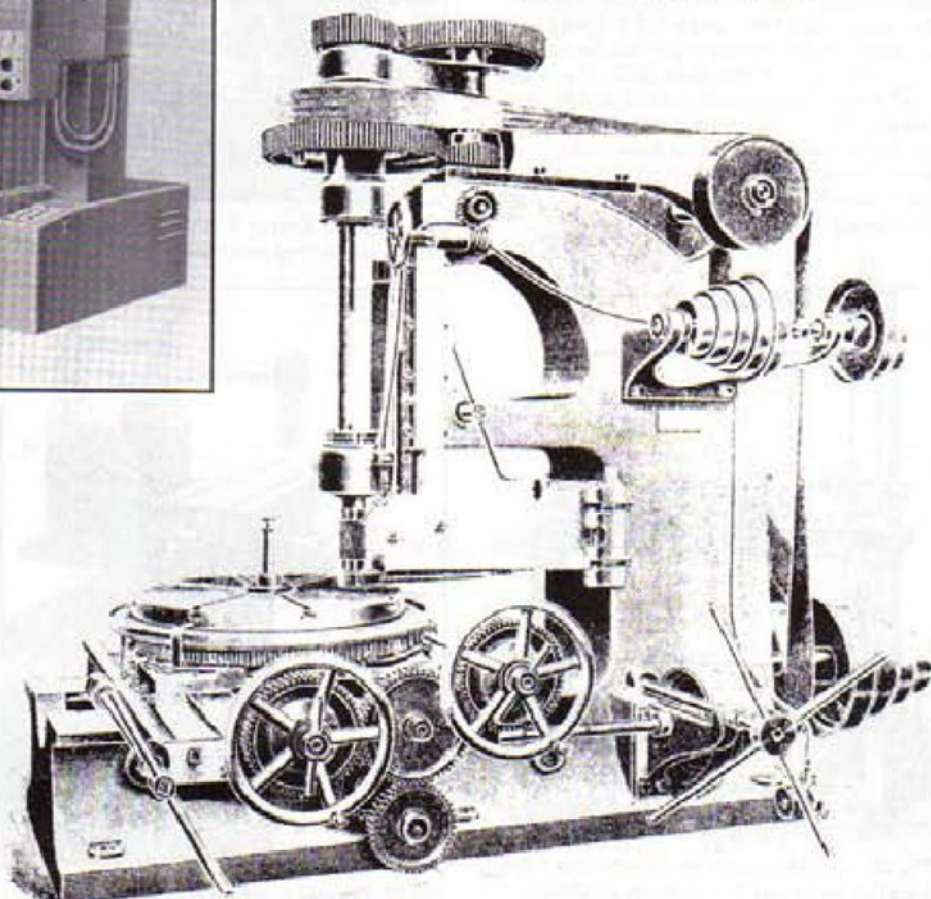
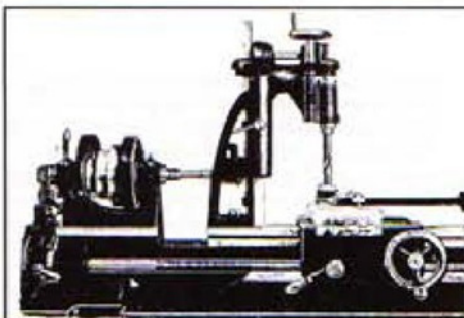


Fig.16: Large A.H. single pulley horizontal milling machine, c1917. Ibid.



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Fig.18: Abwood milling and drilling attachment, 1934.



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TOM SENIOR, "Atlas Works," LIVERSEDGE, Yorks.

Fig.19: Atlas universal milling attachment. (Tom Senior 1934).

amateur market began to become available after the first World War, some being very simple and basic, Fig.22, although others such as the Tom Senior, Fig.23 were excellent machines.

Although the small vertical was available to industry, advertisements did not begin to appear in the model makers press until the mid-1970s; since then the vertical types have become more popular, possibly because being cheaper to manufacture, they have a lower initial cost. Other advantages for the type are that they occupy less space, and the cutters being smaller are cheaper. However, there is still room for the humble milling spindle, in fact I still use mine suitably adapted on my milling machine for cutting racks (see M.E.W. Feb/Mar 1992). It is also useful for other special tasks, Fig.24! By the way notice the differential train of gears on the dividing head, to enable odd numbers of teeth to be cut. This scheme was described in Brown and Sharpe's handbooks of 1875.

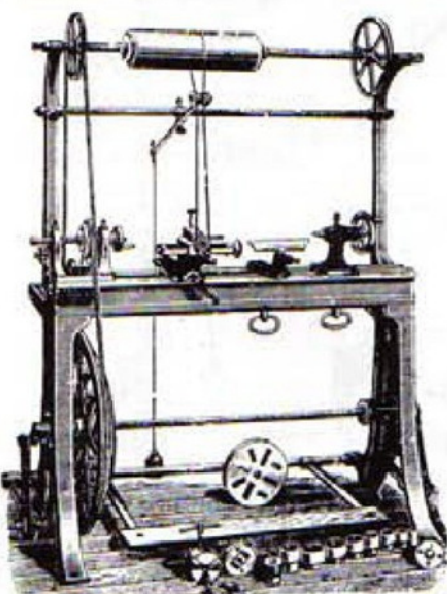


Fig.20: Overhead drive attachment on a lathe, from an illustration in Model Engineer, 1898.

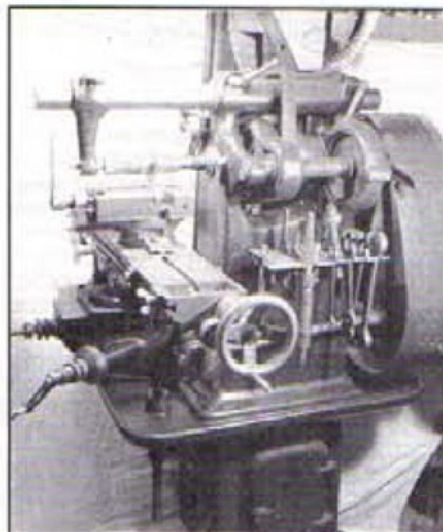


Fig.21: Arno Brown & Sharpe type universal milling machine, c1912.

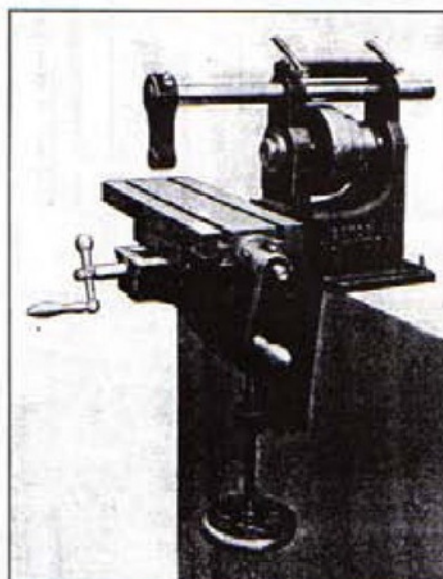


Fig.22: Simple horizontal milling machine by Bonds, 1934.

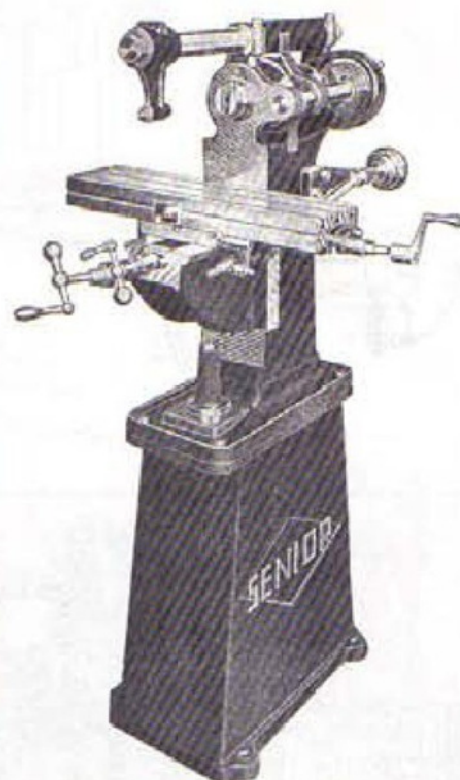


Fig.23: Horizontal milling machine, Tom Senior, 1939.

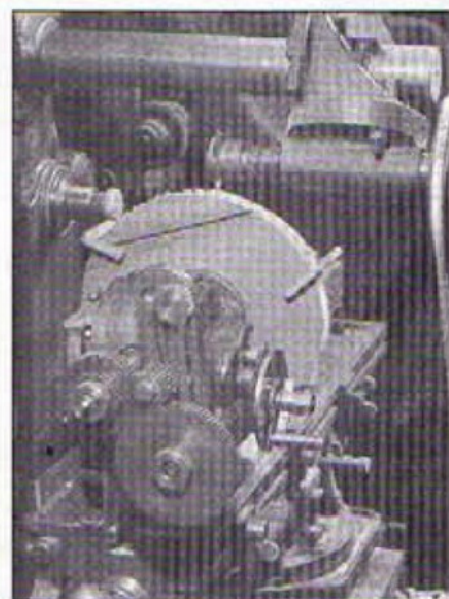


Fig. 24: The author's milling machine with ex-lathe milling spindle fitted in order to cut a large gear wheel. Note the train of gears on the dividing head for the differential indexing odd numbers of teeth.

SCRIBE A LINE

Your views, your pages! Your opportunity to make your point, ask the question or simply pass on a snippet of interesting advice to others. Your letters for publication in *Model Engineers' Workshop* are always welcome

More computer considerations

P A Raper, co-chairman of the Leeds Personal Computer Users Group, offers some comments on the recent Computer article and further advice to readers who may like to write to him.

I received my copy of *Model Engineer's Workshop* on Christmas eve and as usual I enjoyed reading it. As a professional engineer of some 35 years plus I still get as much of "buzz" from this type of magazine as I did from reading *Practical Mechanics* back in the fifties.

My reason for writing is that having read the excellent article on Considerations Before Purchasing A Computer For CAD, I feel however, that because of the time lag, some readers could well have made either a bad purchase or spent rather more than is necessary.

Taking first the paragraph "Computer Specifications". 386X and 486X. This should have said "386sx or dx and 486sx or dx" (**NB. In the 486 range there are now other suffixes but only the 486dx machine has a built in maths co-processor as standard). The extra cost of fitting a co-processor to a 486sx (or other suffix) is as much as it would cost to purchase a 486dx in the first place! Secondly because of the aforementioned difference the line should read "a dx machine is better than an sx machine and a 486 better than a 386, but the cost goes up accordingly and the extra speed and performance gained may not warrant the extra cost by the reader". Thirdly the minimum specification is over the top, thus again costing the reader more than may be necessary. I would recommend as a minimum a 286 computer with 2 Mbyte ram and preferably a co-processor, a 40 Mbyte hard disk, a 1.44 Mbyte floppy disk, a 14in VGA monitor and a mouse, and for printing out onto paper a minimum of a 9 pin dot matrix printer (DMP).

In the paragraph co-processors a statement is made to the effect that a 486 computer does not need a co-processor. Not true, see previous paragraph. Another statement is made that the slower the machine, the more desirable is a co-processor, again simply not true. A co-processor is needed if and only if the software used is written to take advantage of one being present. Otherwise it would simply be a waste of £50 or more.

I would suggest, always seek independent advice before laying out the amount of capital required by a project such as this. Where from you ask? In your local library they may have a list of computer clubs. If there is more than one, try to go to a PC user group (PCUG).

Is there a college or school with a computer course that you can visit? You don't necessarily have to join the course but they may be able to answer some of your questions. Buy a couple of magazines such as *Micro Mart* or *PC Mart*.

In both these magazines you will see some adverts that mention "Shareware". This is the biggest omission from the

article. Software (ie. the programme you use to do your CAD or whatever) can be very expensive and because it will take time for you to get used to the way in which the software package works, you may well be stuck with something that you find unsuitable. This is where Shareware comes in. Shareware is software that is on a try before you buy basis. (Shareware was mentioned in the CAD article, and DraftChoice, one of the recommended packages is a Shareware system Ed.)

To summarise:-

1) Try to get advice locally (a public library is a mine of information) from a college where they have a course on computers. Or preferably from a PCUG (Personal Computer User Group)

2) No matter what the computer or standard, there is probably a CAD program somewhere to suit.

3) Purchase a copy of *Micro Mart*, and/or a copy of *PC Mart* and read through it and get a feel for what you might be letting yourself in for. Look in particular at the advertisements for shareware.

Finally you could by following the advice above save a lot of money. If your requirements are not particularly stringent you could have a CAD system up and

running for under £300, but if you want more then the sky is the limit. One last word of warning: computing is addictive and you could end up with two hobbies or even supplanting the one you already have.

If anyone wants help I am willing to give it as best I am able but they will need to supply stamped addressed envelopes. Write to (not phone) P A Raper, 70 Manor Rise, Walton Wakefield, West Yorks, WF2 6PF.

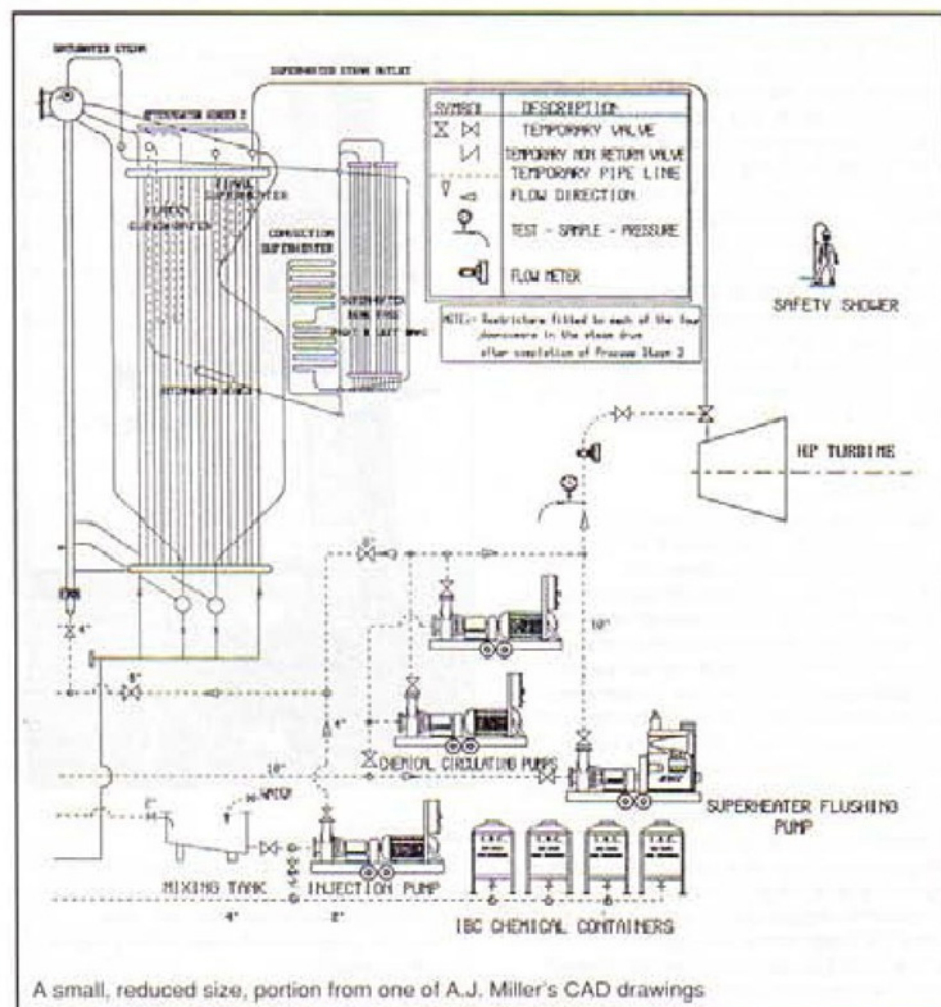
(The above is an extract from a much longer letter. Readers who wish to see the complete letter should send a SAE marked "SAL More Computer Considerations" - Ed.)

CAD Mastered

A. J. Miller of Doncaster offers a word of encouragement to potential CAD users.

I find the recent articles in issue's 20 and 21 on CAD systems very interesting. Perhaps it may encourage your older readers to adopt the use of CAD and a computers, to know that despite all the gobbledygook, and unfamiliar works that surround these devices that they can be mastered even by those getting on in years.

When I was 60, eight years ago, and still actively engaged in a stressful, harassing section of the engineering service industry, I had to take work home weekends and evenings in order to meet quotation closing dates. Striving for some way to ease my workload, and free me from the need to take work home, I purchased what was then the new Amstrad home computer, complete with green screen with the object of using it as a "word processor" to speedily produce technical engineering quotations.



Technical quotations needed to be first hand written, with each document doing the weary time consuming round, to the typist, typed proof, back to me, re-write, typed proof, re-write etc., eventually arriving at a completed acceptable document. Always a lengthy time consuming process, with usually a last minute panic to get the post to meet the dead line.

The computer did not come with a printer or word processing program, these were purchased separately. With some surprise, by dint of persistence, after a comparatively short time I managed to put the three things together, computer, printer, and word processor program to produce acceptable documents, with on disc all the most used paragraphs, words, phrases, technical bits to produce a standard quotation which could then be called up and easily customised for any particular enquiry.

That got rid of the writing, still leaving me with the time consuming need to speedily produce acceptable drawings, usually circuit diagrams, illustrating pumping systems, boilers, heat exchangers etc to go with the quotations.

In the meantime my company was persuaded to purchase an IBM computer for my use in the office. This arrived complete with hard disk, wide carriage dot matrix printer, with an all singing, all dancing combined software programme incorporating word processing, spreadsheet and data manager but no CAD system.

Eventually I purchased a simple CAD system, initially it proved more difficult to learn than the other programmes, the telephone usually interrupted my train of thought. However during a short illness, being confined to home, the computer complete with CAD program was brought to me, and I learnt to produce acceptable drawings within a week, because there were no interruptions!

One of the benefits is that standard patterns can be produced and saved on disc, thus eliminating the need to re-draw many items.

My best advice to all those learning is not to waste time trying to understand how it all works, it is the same as driving a car, you don't need to know how it all works to drive it, all you need to know is where the pedals are to stop, start and steer!

Bearing life

Derek Walters of Tetbury comments on the question of maintenance and anticipated life of rolling bearings.

With reference to recent correspondence on machine tool quality it would seem that there are many people around who are not aware of the service that they can expect from ball and roller bearings. In our case, our machines in the home workshop, if of reputable manufacture and using ball bearings in particular, should expect a life almost, if not, the same as our own life span.

This may seem incredible to many, but if the machine is serviced regularly and with real care to ensure clean oils and greases only being used this is possible. One correspondent talks of his 5/6 years service from a Far East grinder as being good, if the machine castings were badly cleaned of sand and not too carefully assembled then this may be a reasonable life under

these conditions. The ingress of grinder dust through badly fitted seals, or in the case of a lathe cutting fluids and metal dust, will of course drastically shorten bearing life. When bearings are removed for whatever reason, using approved tools and real clean conditions it should not shorten bearing life at all.

In 1946 when I started my apprenticeship, there was a 3/4h.p. Wolf double ended offhand grinder using 6in. dia. wheels 1in. thick in the armature shop which was in constant intermittent use, even then it was probably of pre-war date. Recently, I was taken around the armature shop again, although now in a new works building there was the same old grinder doing the same job. Enquiring to its service record I was taken to see the millwrights who produced its record which showed no bearing changes, it had been stripped twice, bearings washed out and re-packed and greased just once a year only.

From my days in the M.O.D. (N) design drawing office, I have a bearing calculation for a 1in. bore precision bearing for fan motor duty working at 60% load continuous, it was calculated to give 1,346,000hrs. This included twice yearly greasing with 2cc of grease, two strip downs only in its life.

If we buy a good product we should think of bearing life in decades, not in years, providing we look after it of course.

Perhaps even more incredible is how bearings can go on for years sometimes, lubricated by a muddy slurry after seal failure, you find when stripped not a single round ball in the race, but balls of all shapes and often in two halves, the customer only complaining of the machine getting noisy.



Easy on the eyes

Hubert Eiffers of St Albans has purchased a digital slide caliper.

I recently purchased a digital slide caliper - a great boon to the elderly with failing eyesight!

Shortly after this, I needed to mark out a project on the surface plate. I then

remembered the device which I had acquired shortly after the War, which enables a slide caliper to double as a height gauge. I was delighted to find that this antique fitted the new digital caliper exactly, and thus provided me with a digital height gauge at no extra cost. This works very well indeed, particularly using the 'zero' feature on the caliper, which enables a datum point to be created at any height, with plus and minus readings above below the point.

I have not seen this little device in shops or catalogues since then - but it would be very easy to construct one. I enclose photographs to illustrate the device, and the 'digital height gauge'.

This compromise would not find favour in professional workshops, but is perfectly adequate for our home workshops, where the cost of equipment is of great importance!

Float glass, flat or not flat

A letter from Frank Tobin of Staines

Catching up with my newly acquired back-numbers I noticed a letter from Mr K.J. Bradbury of Cheltenham on the subject of float glass. His comment on the surface quality of this glass surprises me. He says that it is "by no means optically flat".

It is, in fact, good enough to use for making flats for astronomical telescopes for which purpose it must be within a quarter wave all over. The only requirement is that it must not have been roughly treated before the amateur telescope maker gets his hands on it; ie. no scratches. As a quarter wave measures about 0.000004in, float glass would be excellent for Mr Bradbury's purposes.

It is often pointed out that float glass is not flat at all but has a curve equal to the earth's curvature. This is quite true, but if you were to work it out you will find that this would still leave it well within the quarter wave requirement. So for our purposes we can take it that this glass is flat.

Locknuts required?

Further thoughts on lock nuts from R. Fuller of Randburg, South Africa.

I would like to thank Mr. Luscon-Jones for correcting my misconception regarding the correct use of locknuts - he is indeed correct in suggesting that I picked this up from a text originally authored by a Prof. D.A. Low of London University in 1898, though my copy of A pocket-book for mechanical engineers is the sixth edition and published in 1959.

In the 1950's I was told that the crankpin nuts of some motorcycle engines had no locking mechanism at all and relied on the face of the nut and the flywheel being dead true to stop them coming loose (I was using a single-knocker Norton engine for 500cc 'Formula 3' racing); I would be grateful if your readers could advise if this is still a valid method of achieving security of a nut and, if so, how true must the faces be and what surface finish is needed.

E.W. Lathe

David Odabashian of Malvern provides some more details regarding the history of the E.W. Lathe.

I have now had copes made for you of various lists etc relating to the E.W. lathe. My recollection is that although I dealt

direct in the first instance with Mr. Stringer (who was then at: Pavement Square, Lower Addiscombe Road, Croydon) and from whom I collected the machine when it was ready; the paper work and payment was done with the Wanstead Supply co. This seems to have been a Mr. E.M. Bostock and I think that he must have had sales and distribution rights for the E.W. I see from correspondence with this company that they were successively located at: 40 High Street, E11; 30 The Broadway, Woodford Green and 82 Snakes Lane, Woodford Green.

(The list referred to are sales leaflets with specifications for the four types of lathe that were available, not manuals. Copies can be obtained by sending large stamped addressed envelope plus 4 first class stamps - Ed.)

REMAP Worthy of our assistance.

A Giannuzzi of Sittingbourne brings to our attention an organisation which can benefit from the assistance of home workshop owners.

Yet again another very clever idea comes out of your great magazine, and I must congratulate J. Neave for it. Being one of those model engineers who keeps making tools but very little modelling I will have a go at this one. (Our Trade Counter page carries details of available castings - Ed) (I believe I made nearly every jig and tool that the late G.H. Thomas had designed, being also a great admirer of him for his superb teaching gift).

But there is a point on which I believe J. Neave has made a mistake. According to the drawings it appears that the lathe would be running forward in the usual way and the arbor with the cutter would run backward, being driven by a Myford gear. Hence the L/H arbor nut. But if this is the case, then the Safety Hints at the end should warn to wind the cross slide inward and not outward, otherwise we will produce a climb milling situation, and the cutter would have to be mounted reversed as I assume the work would be clamped to the cross slide. Apart from this, a very good article. Thanks.

If I am allowed to digress for a moment I wonder if it would be worthwhile bringing to the attention of our model engineer friends an organisation I have joined about a year ago, and from which I have derived a tremendous satisfaction in terms of challenge to solve problems. And they often can do with help in machining small parts. I enclose a brief leaflet but if anybody is interested, the National Organiser whose name is on it, I am sure will be very pleased to help. (The organisation is REMAP. See On The Editors Bench - Ed.)

T Nut manouvering

From R.F. Thomson of Paignton, a suggestion to ease the placing and removing of tee nuts.

When using 'T' nuts on the lathe slides (cross/vertical), I find it very convenient to tap both ends of the nut with a short small threaded hole, say 4BA, into which may be screwed a length of studding, bearing a knurled section of larger diameter at the user end. With lathe slides, the 'T' slots are usually transverse, so that quite a short piece of studding will suffice to push or pull the nut from one end of the slot to the other. This device comes into its own (a) for positioning the nut to accept the

corresponding holding down bolt, or (b) to extract the nut from the slot by pulling, when it would be inconvenient or impossible to push it out.

All the 'T' nuts on my ML7 lathe have been so adapted, and I find it saves much time and frustration. Incidentally I have standardised my nuts on 1in. lengths of 'T' slot material, either home made, or available through channels appearing in M.E.W. from time to time.

Another M.E.W. gearbox variation

P. Smith of Stanley is yet another reader who has made his own version of the screw cutting gearbox published in the Winter 90/91 issue of M.E.W.

I have been meaning to write in for some time now, but have never seemed to get around to it. Anyway about three years ago I decided to make a Screwcutting Gearbox for my IXL lathe, (approx 5in. swing x 22in. B/C). I looked at various designs, but was not altogether happy with any of them. Then on getting the Winter 90/91 edition of M.E.W., I studied the box for the ML7, it had some very interesting features. I thought if I scaled it up to 20DP, it would be ideal for the IXL. (I already had the Gearcutters for these, as the original lathe gears are 20DP). The input drive ratio from the headstock spindle would have to be 2.66-1 to suit the 6 TPI leadscrew, I also made some amendments to the basic design, ball bearings throughout the box, except for the change lever pivot bearings, and the epicyclic sleeve gear. I also decided to drive it from the headstock spindle with a toothed belt drive, mainly on the grounds of silence at high speed, as the tumbler gears were getting a bit noisy (17DP) but I also had the belt pulleys available (15t and 40t). 95% of my work can be done with this set up, but if I need a left hand thread or a metric, it only takes a few minutes to replace the belt with the tumbler gears. The box has performed very well to date, and was well worth the time and effort in construction.

When I was about half way through the above project, I was offered a Cincinnati 10in. Regal with G/Headstock, S/C/G/BOX, and powered cross slide etc., (always happens) a very nice and well looked after machine.

Has anyone got fixed and traveling steadies, and T slotted cross slide for a 10in. Regal?

I think I read somewhere in M.E.W. of someone making Motorcycle Fork Spindles from old half shafts, rescued from a scrapyard: this is not advisable, as by the very nature of the job, they are subject to severe twisting, this forms minute cracks throughout the shaft until fracture occurs. Should this happen when you are riding along the road and the front forks come adrift at speed, it could be fatal. Far better buy a piece of good quality steel, for what it would cost, better than dead. By all means use some of the excellent scrap materials available, but not in highly stressed situations.

Onto smaller things, I have recently completed a Keats angle plate and two small matching vices from College Engineering, compared with some castings I have machined from various suppliers, these were very good indeed, no hard spots and plenty of excess material over the design dimensions.

I was very interested to read the articles

BSP thread outside diameters

Pipe threads are determined by the bore size of the pipe being screwed and not the major diameter of the thread. The diameter of the thread, therefore, is always considerably larger than its nominal size, e.g. 1/2in. BSP has a thread diameter of over double (0.518in.) its nominal size.

Alan Jeeves

on CAD and computer choice, unfortunately I cannot afford a top of the range 486 at the moment, likewise the articles on the history of machine tools. Has anyone any history of IXL Lathes, I think they were supplied by Buck & Ryan, London, but that is all I know.

Not a bad buy

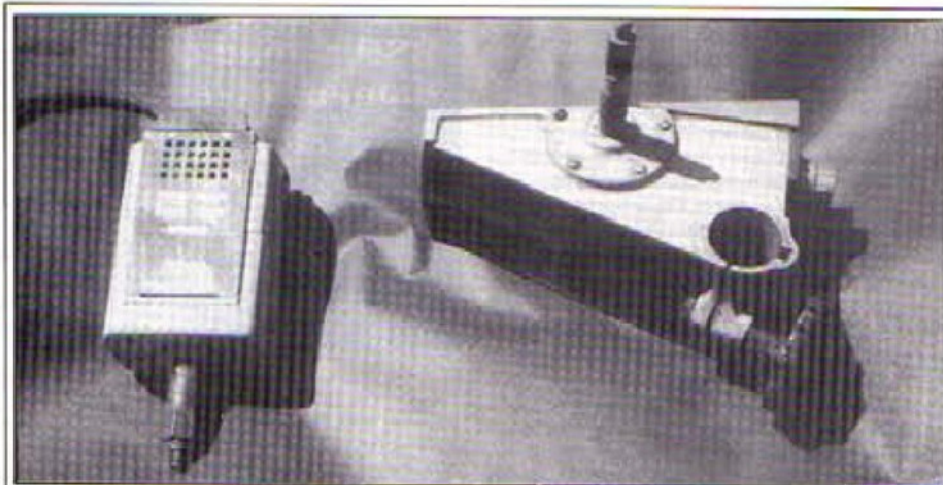
Bill Morris, of Palmerston North New Zealand, comments on his favourable experiences with East Asian machinery and tools.

I would like to comment on P Stallard's letter about third world machines in issue 19 of M.E.W. that arrived here two days ago. "I own a 1327BH lathe, made by the Wai Yui Corporation of Taiwan and published a review of it in Model Engineer in May 1990. Complete with two chucks, steadies, hardened bed and 2H.P. single phase motor, it cost me roughly what a bare Myford ML7 would have cost. For its price, it is an excellent machine and the only real criticism I could make of it was that the paint job on one of the headstock covers was very poor. The quality of the metal bits is first class with evidence of careful hand fitting of critical parts. It came with a comprehensive test certificate which I checked myself and found to be accurate.

I have a mill drill from Taiwan which, while not in the same class as the lathe, represents excellent value for money. I have made minor adjustments here and there and a few additions to improve ease of belt changing and remove backlash from the quill feed, but it is a sound, basic machine.

My small sensitive drill from Taiwan has (or had) a flimsy base, and inadequate column, a sloppy quill fit and an underpowered motor, but cost me very little, I fitted a new base and made a new quill and still think I got value for money. My Taiwanese bandsaw also needed a few improvements but could not be bettered at the price I paid for it.

My Taiwanese machine vice and rotary table and my Japanese dividing head cannot be faulted. Very little that is shoddy ever leaves Japanese shores these days. Many Taiwanese and Korean firms are Japanese financed and follow Japanese management and quality control practices. One has only to reflect on the death of the German camera industry and the hard times of the American motor industry to realise that carping about quality of East Asian machinery is misplaced. In general, you get what you pay for. Some is of very patchy quality, but on the whole, quality is very good and improving rapidly. When you buy a secondhand machine you may get a pig in a poke unless you have the knowledge and the time to spend carefully inspecting it.



Selecta Tooling

Bill Griffin of Mentone Australia has acquired some Selecta accessories for which he would like to receive advice as to their method of use.

Thank you for a fine practical workshop magazine it reminds me very much of the weekly Practical Mechanics published for many years.

My main point of writing is to seek help regarding a number of Selecta Accessories I have recently purchased. I have a Selecta Homemaster kit and am conversant with the normal set-up. However, I now have two pieces of Selecta tooling which I am concerned.

1) Selecta power pack s/n. 1068, input watts 400, 60 cycle, 750 rpm, 240V.

2) A buzzer with a flexible drive.

Can any reader assist regarding their usage with the basic machine, or are they intended to be used as separate items of



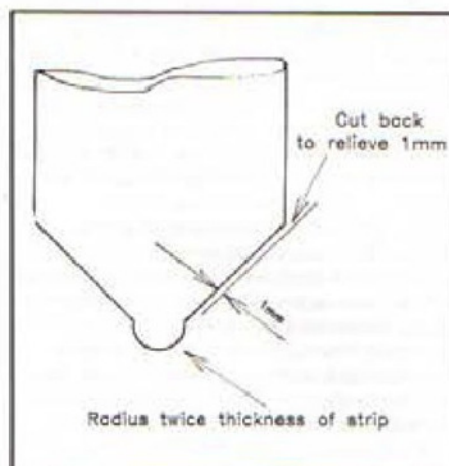
equipment. Any info would be appreciated.

(In a subsequent letter Bill provided the photos published with this letter, and in this letter also mentions a planer. Apparently the Selecta was also made in Australia. - Ed.)

Spring back

P A Clist from Ayr comments on the bench press articles.

I have been interested in the articles on bench presses and would wish to comment regarding the bending of the thicker materials.



There is a general rule that the inside bending radius is at least twice the thickness of the material to be bent. This will explain why the author of the article was successful with a 6mm radius for 3mm thick strip and not so with a 3mm radius. If he had put a 10mm radius on the punch he

would have been successful also with the 5mm strip. This general rule is applicable also to sheet metal work, particularly to light alloy work.

Regarding 'spring back' this can be obviated to a certain extent, by reducing the angle of the block (difficulty of doing so accepted) or by relieving the punch by about 1mm on the flats away from the radiused section. (See sketch). This latter method initiates a 'coining' action to the punch when operated, squeezing the strip in the area of the bend. Although a similar action is given by relieving the Vee of the block, as explained in the article, relieving the punch would not result in the marking of the outside of the strip, and also would not give so much wear to the block, important if several bends are to be run off with a non heat treated block.

The following table may help in determining 'spring back', it is the only information to hand, and this from an old text on metal forming.

Type of Steel	Degree of spring back
Low carbon, bent hot	0.5 to 1.0
Low carbon, annealed	1.0 to 2.0
0.4 to 0.5 carbon	3.0 to 4.0
Open hearth spring, annealed	10.0 to 15.0

The above is for 0.25in. to 0.375in. strip bent to 90 degrees.

Revised Opinion

From D.M. Hodges, editor of the Steam Correspondence Circle's newsletter

Thank you for your kind remarks re the Steam Correspondence Circle's newsletter, now in its third year. The biggest problem initially was a sufficiency of material - I'm sure that you know the feeling - but we are now in fairly good shape, with members able to assist with layout via DTP.

Personally I find your magazine most interesting, also excellent value, and now look forward to the time when I have the leisure to actually make something from one of the projects therein. Although I will never get around to employing CAD for example, I thought the recent clear exposition most enlightening and quite revised my opinion vis-a-vis the more traditional draughting approach.

Editorial preferences, 50:50

A letter from John Alton of Amesbury. The small number of letters on this subject, for and against, are about equally matched.

Unlike Cllr. R.T.C. Biggs who wrote to Scribe a Line in the January/February issue, I very much appreciate your comments.

I imagine few of us have the knowledge and experience to accurately assess the contents of all readers contributions, they do cover a diversity of subjects and thus your comments can be very helpful.

Model cranes without machines

Two replies regarding the enquiry in issue 20 for details of model cranes have been received. The first from Peter Anderson of Henley on Thames.

I am writing in response to P.C. Westnott's request for crane plans - models without a machine shop, M.E.W. January/February 1994 page 71.

In 1979, the Bristol Industrial Museum published a plan entitled Cranes on Primes Wharf Bristol showing the dockside cranes on the wharf where the museum is situated. It included details of three electric traveling cranes and a 35 ton steam crane built in, respectively, 1949 and 1876/7 by Stothert and Pitt of Bath. The plans were to a small scale and showed outside details only.

A Hobbies fretwork plan for a model of a Coles Mobile Crane was published as designs No.2884 dated 7/2/51. It is not in the current catalogue. The model, if built direct from the plan, would be about 30cm long overall.

Crane makers catalogues can sometimes contain small scale plans. That of Herbert Morris Ltd of Loughborough, certainly for the early years of the century, included plans for hand and electrically operated overhead cranes.

Finally, Model Aeronautical Publications, now Argus of course, published in 1958 G.H. Deason's book Cardboard Engineering with Scissors and Paste. One of the models was a Ruston Bucyrus IORB excavator with skimmer bucket, drayshoud and crane boom. Not an exact scale model but a good representation nonetheless.

As the availability, I suggest contacting the Bristol Industrial Museum at Primes Wharf, Primes Street, Bristol BS2 9JA for the first item.

Hobbies (Dereham) Ltd, Dereham, Norfolk NR19 2AZ may possibly be able to help with the fretwork plan.

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Article No. 4 is a small table-top model by Tubal Cain but is operated by a steam boiler, which Mr Westcott says he isn't interested in, and also requires some machining work. Very nice but doesn't really fit the requirements of our Australian correspondent.

Alan Jeeves

Article No. 5 is very useful and gives information on large modern mobile cranes etc, which Mr Westcott quite likely has in mind for building himself. This is an excellent series written by Adrian Harris, who is a modeller himself and he illustrates and describes various designs of cranes and the techniques in building them, using the types of materials contemplated by Mr Westcott. No special machinery is involved and the modeller can succeed with using hand tools carefully. The author, Mr Harris, says there are no plans published for cranes, which is surprising, but his article and that also of Mr Cleeve are of great use and value to anyone like Mr Westcott who is seriously contemplating building a model of their own of which they would be proud.

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